Designation: D7099 – 04 (Reapproved 2010)

Standard Terminology Relating to Frozen Soil and Rock[1]

This standard is issued under the fixed designation D7099; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This terminology includes all of those terms which relate to frozen soils and rocks.

1.2 It is based on: a list of definitions drawn up by ASTM Sub-Committee D18.19; ASTM standards; a list of definitions drawn up by the Canadian Geomorphology Research Group (CGRG); the Glossary of Permafrost and Related Ground-Ice Terms developed by the National Snow and Ice Data Center (NSIDC), at the University of Colorado, at Boulder; the Keys to Soil Taxonomy of the United States Department of Agriculture (USDA); and contributions by a number of individuals.

1.3 For all of the terms included, the source is included in parentheses after the definition.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D653 Terminology Relating to Soil, Rock, and Contained Fluids

D4083 Practice for Description of Frozen Soils (Visual-Manual Procedure)

2.2 *Other References:*

Harris, S. A., French, H. M., Heginbottom, J. A., Johnston, G. H., Ladanyi, B., Sego, D. C., and van Everdingen, R. O., 1988, Glossary of Permafrost and Related Ground-Ice Terms, Technical Memorandum, Associate Committee on Geotechnical Research, Ottawa, Canada

Everdingen, Robert van, ed., 1998, revised January, 2002, Multi-Language Glossary of Permafrost and Related Ground-Ice Terms, National Snow and Ice Data Center/World Data Center for Glaciology, Boulder, Colorado

National Snow and Ice Data Center, 2003, English Language Glossary of Permafrost and Related Ground-Ice Terms, Boulder, Colorado, http://nsdic.org/fgdc/glossary/english.html

Natural Resources Conservation Service, United States Department of Agriculture, Keys to Soil Taxonomy, Ninth Edition, 2003, 331 pp., http://soils.usda.gov/technical/classication/tax_keys

Permafrost Map of the USSR (1:2,500,000), 1996, Department of Geocryology, Moscow State University, 16 sheets

3. Significance and Use

3.1 This terminology can be used to find the definitions of all of those terms which are used in association with frozen materials, including rocks, soils, and water.

4. Terminology

4.1 *Definitions:*

4.1.1 All of the definitions are consistent with those listed in Terminology D653.

active layer—the top layer of ground that is subject to annual freezing and thawing. (In the zone of discontinuous permafrost, the active layer is often underlain by unfrozen ground.)

active layer failure—any of several possible forms of slope failure in the active layer. **NSIDC**

active layer thickness—the thickness of the top layer of ground that is subject to annual freezing and thawing. **NSIDC**

active rock glacier—a mass of rock fragments and finer material, on a slope, that contains an ice core or interstitial ice, and which shows evidence of recent movement. **NSIDC**

adfreeze shear strength—the shear stress required to separate two objects that are bonded together by ice.

adfreeze tensile strength—the tensile stress required to separate two objects that are bonded together by ice. **NSIDC**

adfreezing—the process by which objects are bonded together by the ice formed between them. **NSIDC**

[1] This terminology is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.19 on Frozen Soils and Rock.

Current edition approved Feb. 15, 2010. Published March 2010. Originally approved in 2004. Last previous edition approved in 2004 as D7099 – 04. DOI: 10.1520/D7099-04R10.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

aggradation of permafrost—see **permafrost aggradation**.

aggradational ice—newly formed ice lenses, especially in the lower part of the active layer, which become incorporated into the permafrost due to a raising of the permafrost table or a lowering of the permafrost base.

air freezing index—see **freezing index**.

air thawing index—see **thawing index**.

albedo—the fraction of the total solar radiation incident on a body that is reflected by it.

alpine permafrost—permafrost developed in temperate climate mountainous areas.

altitudinal permafrost limit—the lowest altitude at which mountain permafrost occurs in a highland area outside of the general permafrost region. **NSIDC**

altitudinal permafrost zonation—the vertical subdivision of mountain permafrost into zones based on mean annual temperatures. **NSIDC**

apparent heat capacity—the amount of heat required to raise the temperature of a unit mass of frozen ground by one degree. It is expressed in Joules per kg per degree K. **NSIDC**

approximate freezing index—the cumulative number of degree-days below 0°C for a given period, calculated from the mean monthly temperatures for a given station without making corrections for positive degree-days in the spring and fall. **NSIDC**

approximate thawing index—the cumulative number of degree-days above 0°C for a given period, calculated from the mean monthly temperatures for a given station without making corrections for negative degree-days in the spring and fall.

artificial ground freezing—the process of freezing earth materials by artificial means.

banded cryogenic fabric—a distinct soil morphology in which soil particles form subhorizontal layers as the result of freezing and thawing. **NSIDC**

barrens—areas of discontinuous vegetation cover in the polar semi-desert of the High Arctic. **NSIDC**

basal cryopeg—a layer of unfrozen ground, forming the basal portion of permafrost, in which the temperature is perennially below 0°C (32°F). **NSIDC**

basal cryostructure—the structural characteristics of a frozen deposit of boulders that is saturated with ice. **NSIDC**

basal-layered cryostructure—the structural characteristics of a frozen layered deposit of gravel and boulders that is saturated with ice. **NSIDC**

beaded stream—a characteristic pattern of small streams underlain by ice wedges. "Beads," or pools, occur at junctions of wedges. The pools are linked by narrow channels. **NSIDC**

bottom temperature of snow cover—temperature measured at the base of the snow cover during mid- to late-winter (February/March). The measurements are used in the BTS method to predict the presence or absence of permafrost. **NSIDC**

BTS method—a method to predict the presence or absence of permafrost in a mountainous area, using measurements of the bottom temperature of the snow in mid- to late-winter. **NSIDC**

buried ice—ice formed on the ground surface and later covered by sediments.

candled ice—ice that has rotted or otherwise formed, by melting during the spring, into long columnar crystals which are very loosely bonded together. A distinctive "chiming" sound accompanies movement during "ice-out."

cave ice—ice formed in an open or closed cave. **NSIDC**

clear ice—ice that is transparent and contains only a moderate number of air bubbles.

closed-cavity ice—ice formed in a closed space, cavity, or cave, in permafrost. **NSIDC**

closed-system freezing—freezing that occurs under conditions that preclude the gain or loss of water by the system. **NSIDC**

closed-system pingo—a pingo formed by the doming of frozen ground due to the freezing of injected water. The water is provided by the expulsion of pore water during the growth of permafrost. Closed-system pingos are found in poorly-drained terrain in the continuous permafrost zone. **NSIDC**

closed talik—a body of unfrozen ground occupying a depression in the permafrost table below a lake or river. **NSIDC**

cloudy ice—ice that is translucent or relatively opaque due to the content of air or for other reasons, but which is essentially sound and nonpervious.

coefficient of compressibility—the change in volume per unit volume of a substance per unit increase in effective compressive stress, under isothermal conditions. **NSIDC**

collapse scar—that part of a peatland where the whole, or part, of a peat plateau has thawed and collapsed to the level of the surrounding land. Collapses scars are not depressions but are marked by vegetation different from the peatland that was not underlain by permafrost. **NSIDC**

composite wedge—a wedge, containing both soil and ice, that shows evidence of both primary and secondary filling. **NSIDC**

compressive strength—the load per unit area at which an unconfined cylindrical specimen of soil or rock will fail in a simple compression test. Commonly the failure load is the maximum that the specimen can withstand in the test. **D653**

conglomeric cryogenic fabric—a distinct soil micromorphology resulting from the effects of freezing and thawing, in

which coarser soil particles form compound arrangements. **NSIDC**

construction methods in permafrost—special procedures of design and construction that are required when engineering works are undertaken in areas of permafrost.

contemporary permafrost—*(1)* newly formed permafrost in an area where surface temperatures have fallen below 0°C (32°F); *(2)* permafrost that is in thermal equilibrium with the existing mean annual surface or sea-bottom temperature and the geothermal heat flux.

continuous permafrost—permafrost occurring everywhere beneath the exposed land surface throughout a geographic region, with the exception of widely scattered sites, such as newly-deposited unconsolidated sediments, where the climate has just begun to impose its influence on the ground thermal regime and will cause the formation of continuous permafrost.

continuous permafrost zone—a major subdivision of a permafrost region, in which permafrost occurs everywhere beneath the land surface, with the possible exception of widely scattered sites; both in North American (GPRGIT) and in Russian (Permafrost Map of the USSR) usage: >80 % of area underlain by permafrost.

convection tube—a closed single-phase heat transfer device that removes heat from the ground whenever conditions are appropriate to drive the internal convection cell.

creep of frozen ground—the slow deformation that results from long-term application of a stress too small to produce failure in the frozen material.

creep strength—the failure strength of a material at a given rate of strain or after a given period under deviatoric stress. **NSIDC**

crust-like cryostructure—the structural properties of a frozen deposit of angular blocks that are coated with ice, while large spaces between the blocks are not filled with ice. **NSIDC**

cryofront—the boundary between frozen and unfrozen ground, as indicated by the position of the 0°C isotherm in the ground. **NSIDC**

cryogenesis—the combination of thermophysical, physico-chemical, and physico-mechanical processes that occur in freezing, frozen, and thawing earth materials. **NSIDC**

cryogenic aquiclude—a frozen layer of ground with sufficiently low permeability as to act as a confining bed for an aquifer. **NSIDC**

cryogenic fabric—the distinct soil micromorphology which results from the effects of freezing and thawing processes. **NSIDC**

cryogenic temperature—the term can apply to temperatures below −50°C but is usually used for those temperatures close to absolute zero (−273°C). **NSIDC**

cryolithology—the study of the genesis, structure, and lithology of frozen earth materials. **NSIDC**

cryopedology—the study of soils at temperatures below 0°C.

cryopeg—a layer of unfrozen ground in which the temperature is perennially below 0°C. In general, the freezing of such layers is prevented due to the depression of the freezing point by solids dissolved in the pore water.

cryoplanation—the process through which cryoplanation terraces form. **NSIDC**

cryoplanation terraces—hillside benches or table-like summit surfaces which are thought to have resulted from intense frost wedging associated with snowbanks. These are usually underlain by permafrost and are considered by some as diagnostic landforms of permafrost terrain. **NSIDC**

cryosol—soil within 1 to 2 m of the surface in which the mean annual ground temperature is below 0°C. **NSIDC**

cryosphere—that part of the Earth's crust, hydrosphere, and atmosphere subject, for at least a part of each year, to temperatures below 0°C (32°F). **NSIDC**

cryostructure—the structural characteristics of frozen earth materials. **NSIDC**

cryosuction—a suction which develops in freezing or partially-frozen fine-grained materials due to temperature-dependent differences in unfrozen water content. **NSIDC**

cryotexture—the textural characteristics of frozen earth materials cemented together with ice. **NSIDC**

cryotic ground—soil or rock in which the temperatures are 0°C, or below. **NSIDC**

cryoturbate—a body of earth material moved or disturbed by the action of frost. **NSIDC**

cryoturbation—*(1)* a collective term to describe all soil movements due to frost action; *(2)* irregular structures formed in earth materials by deep frost penetration and frost action processes. **NSIDC**

debris flow—a sudden and destructive form of landslide, in which loose materials on a slope, with at least half of the particles being larger than sand, are mobilized by saturation and flow downwards. **NSIDC**

deformability—the ability of a material to change its shape or size under the influence of an external or internal agency. **NSIDC**

degree-day—a unit of heat measurement equal to one degree of the variation of the mean temperature for a day from a given reference (or, base) temperature.

degree of saturation—*(1)* the total degree of saturation of frozen soil is the ratio, expressed as a percentage, of the volume of ice and unfrozen water in the soil pores to the volume of the pores; *(2)* the degree of saturation of frozen soil by ice, expressed as a percentage, is the ratio of the

volume of ice in the soil pores to the volume of the pores. **NSIDC**

density of frozen ground—the ratio of mass per unit of volume of frozen earth materials.

depth of seasonal frost penetration—the maximum thickness of the seasonally frozen layer. **NSIDC**

depth of thaw—the distance from the ground surface downward to frozen ground at any time during the thaw season.

depth of zero annual amplitude—the distance from the ground surface downward to the point beneath which there is virtually no annual fluctuation in the mean ground temperature.

desiccation crack—a crack or fissure in fine-grained soil material resulting from shrinkage during drying. **NSIDC**

desiccation polygon—a closed, multi-sided, pattern in the ground formed by desiccation cracks in fine-grained soils. **NSIDC**

design depth of frost penetration—*(1)* in North American usage: the mean of the three largest depths of seasonal frost penetration measured during the past thirty years, or, the largest depth of seasonal frost penetration beneath a snow-free soil surface measured during the past ten years; *(2)* in Russian usage: the mean of the depths of seasonal frost penetration during at least the last ten years with the ground surface free of snow and the groundwater level beneath the depth of seasonal frost penetration. **NSIDC**

detachment failure—a slope failure in which the thawed or thawing part of the active layer detaches from the underlying frozen material. **NSIDC**

dielectric constant—a measure of the ability of a material to store electrical energy in the presence of an electrostatic field.

dilation crack—a tensile fracture in a frozen material caused by surface extension due to doming, slope or embankment movement, or toppling.

dilation crack ice—ice that forms in dilation cracks. **NSIDC**

discontinuous permafrost—permafrost occurring in some areas beneath the ground surface throughout a geographic region where other areas are free of permafrost.

discontinuous permafrost zone—a major subdivision of a permafrost region in which permafrost occurs in some areas beneath the ground surface while other areas are free of permafrost; *(1)* in North American usage: 30 to 80 % of area underlain by permafrost; *(2)* in Russian usage: 3 to 80 % of area underlain by permafrost. **GPRGIT; Permafrost Map of the USSR, 1996**

disequilibrium permafrost—permafrost that is not in thermal equilibrium with the existing mean annual surface or sea-bottom temperature and the geothermal heat flux. **NSIDC**

drunken forest—a group of trees leaning in random directions in a permafrost region; usually associated with thermokarst topography.

dry density—the mass of a unit volume of dried material. **NSIDC**

dry frozen ground—frozen ground with a very low total water content, consisting almost completely of interfacial water, and not cemented by ice. **NSIDC**

dry permafrost—perennially frozen soil or rock without ice, or with an ice content lower than the pore volume, so that it does not yield excess water on thawing.

dynamic modulus of elasticity—the ratio of stress to strain for a material under dynamic loading conditions. **NSIDC**

dynamic Poisson's ratio—the absolute value of the ratio between the linear strain changes, perpendicular to and in the directions of a given uniaxial stress change, respectively, under dynamic loading conditions. **NSIDC**

earth hummock—a hummock having a core of silty and clayey mineral soil which may show evidence of cryoturbation. **NSIDC**

electrical conductivity—the property of conducting electricity.

electrical properties of frozen ground—these include the: dielectric constant, electrical conductivity, and electrical resistivity.

electrical resistivity—the property of a material that determines the electrical current flowing through a centimeter cube of the material when an electrical potential is applied to the opposite faces of the cube. **NSIDC**

epigenetic ice—ice in the ground that formed after the deposition of the earth material in which it occurs.

epigenetic ice wedge—an ice wedge that developed after the deposition of the earth material in which it occurs.

epigenetic permafrost—*(1)* permafrost that formed after the deposition of the earth material in which it occurs; *(2)* permafrost that formed through the lowering of the permafrost base in previously deposited material. **NSIDC**

equilibrium permafrost—permafrost that is in equilibrium with the existing mean annual surface or sea-bottom temperature and with the geothermal heat flux. **NSIDC**

excess ice—the ice in the ground that exceeds the total volume of the pores that the ground would have under natural unfrozen conditions.

fabric—the micromorphology of soil.

fragmic cryogenic fabric—a distinct soil micromorphology, resulting from processes of freezing and thawing, in which soil particles form discrete units that are densely packed. **NSIDC**

fragmoidal cryogenic fabric—a distinct soil micromorphology, resulting from the processes of freezing and thawing, in which soil particles form discrete units that are coalescing. **NSIDC**

frazil ice—crystals of ice that form in turbulent streams in cold weather.

free water—that portion of the pore water that is free to move between interconnected pores under the influence of gravity. **NSIDC**

freeze-thaw cycle—the freezing of a material followed by thawing.

freezeback—refreezing of thawed materials. **NSIDC**

freezing (of ground)—the changing of phase from water to ice in soil or rock. **NSIDC**

freezing front—the advancing boundary between frozen (or partially frozen) and unfrozen ground. **NSIDC**

freezing index—*(1)* the cumulative number of degree-days below 0°C for a given period; *(2)* the number of degree-days between 0°C (32°F) and the mean temperature each day. The index is determined from temperatures measured about 1.4 m (4.5 ft) above the ground surface. That determined from temperatures measured at, or immediately below, a surface is known as the **surface freezing index**.

freezing point—*(1)* the temperature at which a pure liquid solidifies under atmospheric pressure; *(2)* the temperature at which a ground material starts to freeze. **NSIDC**

freezing-point depression—the number of degrees by which the freezing point of an earth material is depressed below 0°C (32°F).

freezing pressure—the positive pressure developed at ice-water interfaces in a soil as it freezes. **NSIDC**

friable—a condition under which the material is easily broken up under light to moderate pressure.

friable permafrost—permafrost in which the soil particles are not held together by ice. **NSIDC**

frost—the occurrence of air temperatures below 0°C. **NSIDC**

frost action—the process of alternate freezing and thawing of moisture in soil, rock, and other materials, and the resulting effects on materials and on structures placed on, or in, the ground.

frost blister—a seasonal frost mound produced through doming of seasonally frozen ground through a subsurface accumulation of water under elevated hydraulic potential during progressive freezing of the active layer. The areas affected can be quite large. **NSIDC**

frost boil—a small mound of soil material, presumed to have been formed through frost action. **NSIDC**

frost bulb—a more-or-less symmetrical zone of frozen ground formed around a buried chilled pipeline, or beneath or around a structure maintained at temperatures below 0°C (32°F).

frost cracking—fracturing of the ground by thermal contraction at temperatures below 0°C (32°F).

frost creep—the net downslope displacement that occurs when a soil, during a freeze-thaw cycle, expands normal to the ground surface and settles in a nearly vertical direction. **NSIDC**

frost heave (heaving)—the upward or outward movement of the ground surface (or objects on, or in the ground), caused by the formation of ice in the soil. **NSIDC**

frost-heave extent—the difference between the elevations of the ground surface before and after the occurrence of frost heave. **NSIDC**

frost jacking—the cumulative upward or outward displacement of slabs or blocks of rock, or of objects embedded in the ground, due to repetitive freezing and thawing.

frost mound—any mound-shaped landform produced by ground freezing combined with accumulation of ground ice due to groundwater movement or the migration of soil moisture. **NSIDC**

frost penetration—the movement of the freezing front into the ground during freezing. **NSIDC**

frost phenomena—the effects on earth material and structures resulting from frost action. **NSIDC**

frost shattering—the mechanical disintegration of rock caused by the pressure of the freezing of water in pores and along grain boundaries. **NSIDC**

frost sorting—the differential movement of soil particles of different size ranges as a result of frost action. **NSIDC**

frost-stable ground—soil or rock in which little or no segregated ice forms during seasonal freezing. **NSIDC**

frost-susceptible ground—soil or rock in which segregated ice will form, causing frost heave, under the required conditions of moisture supply and temperature. **NSIDC**

frost weathering—the disintegration and break-up of soil or rock by the combined action of frost shattering, frost wedging, and hydration shattering. **NSIDC**

frost wedging—the mechanical disintegration, splitting, or breaking-up of rock caused by the pressure of the freezing of water in cracks, crevices, pores, joint, or bedding planes. **NSIDC**

frozen fringe—the zone in a freezing, frost-susceptible soil between the warmest isotherm at which ice exists in pores and the isotherm at which the warmest ice lens is growing.

frozen ground—soil or rock in which all or part of the pore water has turned into ice. **NSIDC**

gas hydrate—a special form of a solid lattice-like structure in which crystal lattice cages or chambers consisting of host molecules (water) enclose guest molecules (of a variety of gases). **NSIDC**

gelifluction—the slow downslope flow of unfrozen earth materials on a frozen substrate. **NSIDC**

gelisol—perennially frozen soil that contain permafrost within 2 m of the surface. **USDA**

geocryology—the study of earth materials having a temperature below 0°C (32°F).

geothermal gradient—the rate of temperature increase with depth in the earth.

geothermal heat flux—the amount of heat moving steadily outward from the interior of the earth through a unit area in unit time. **NSIDC**

glacial till (till)—material left after the retreat of glaciers and ice sheets, usually composed of a wide range of particle sizes, which has not been subjected to the sorting action of water. **D653**

glaciolacustrine deposits—glaciofluvial deposits that settled in standing water.

granic cryogenic fabric—a distinct soil micromorphology, resulting from the processes of freezing and thawing, in which soil particles form discrete loosely packed units. **NSIDC**

granoidic cryogenic fabric—a distinct soil micromorphology, resulting from the processes of freezing and thawing, in which soil particles form more-or-less discrete loosely packed units. **NSIDC**

granular ice—ice that is composed of coarse, more-or-less equi-dimensional, crystals that are weakly bonded together.

gravimetric (total) water content—the ratio, expressed as a percentage, of the mass of the water and ice in a sample to the dry mass of the sample. **NSIDC**

ground ice—*(1)* ice in pores, cavities, voids, or other openings in soil or rock, including massive ice; *(2)* a general term referring to all types of ice in freezing and frozen ground. **NSIDC**

ground settlement—downward movement of the ground causing a lowering of the ground surface resulting from the melting of ground ice in excess of that contained in pore fillings.

hard frozen ground—frozen soil or rock which is firmly cemented by ice. **NSIDC**

heat capacity—the amount of heat required to raise the temperature of a unit mass of a substance by one degree. It is commonly expressed in Joules per kg per degree K. **NSIDC**

heaving pressure—upward pressure developed during freezing of the ground. **NSIDC**

high-center polygon—an ice-wedge polygon in which melting of the surrounding ice wedges has left the center in a relatively elevated position. **NSIDC**

histel—a suborder of gelisol that contains large quantities of organic matter. **USDA**

hydraulic conductivity—the volume of fluid passing through a unit cross section in unit time under the action of a unit hydraulic potential gradient. It is commonly expressed in cm/second or m/day. **NSIDC**

hydraulic diffusivity—the ratio of the hydraulic conductivity and the storage capacity of a groundwater aquifer. **NSIDC**

hydraulic thawing—artificial thawing and removal of frozen ground by the use of a stream or jet of water under high pressure. **NSIDC**

hydrochemical talik—a layer or body of unfrozen ground, at a temperature of less than 0°C, in a permafrost area, which remains unfrozen due to moving mineralized groundwater. **NSIDC**

hydrothermal talik—a layer or body of unfrozen ground, at a temperature above 0°C, in an area of permafrost, which is maintained by moving groundwater. **NSIDC**

ice—water in the frozen, solid, state.

ice-bearing permafrost—permafrost that contains ice. **NSIDC**

ice-bonded permafrost—ice-bearing permafrost in which the soil particles are cemented together by ice. **NSIDC**

ice, candled—see **candled ice**.

ice content—*(1)* the ratio, expressed as a percentage, of the weight of the ice phase to the weight of dry soil; *(2)* the ratio, expressed as a fraction, of the volume of ice in a sample to the volume of the whole sample. In the volumetric calculation the ratio cannot exceed unity. In the gravimetric calculation, the percentage can exceed 100 %. **NSIDC**

ice-cored topography—topography that is due almost solely to differences in the amount of excess ice underlying the surface. **NSIDC**

ice crystal—a very small individual crystal or particle of ice visible in, or on, the face of a mass of soil or rock. Crystals may occur alone, or in combination with other ice formations.

ice, epigenetic—see **epigenetic ice**.

ice, excess—see **excess ice**.

ice, frazil—see **frazil ice**.

ice lens—a lens-shaped body of ice ranging in thickness from hairline to 0.3 m. Ice layers more than 0.3 m in thickness are better termed massive ice beds.

ice lenses—lenticular formations of ice in soil occurring essentially parallel to each other, generally normal to the direction of heat loss, and commonly in repeated layers.

ice nucleation temperature—the temperature at which ice first forms during freezing of a soil/water system that does not initially contain ice. **NSIDC**

ice-rich permafrost—perennially frozen ground that contains ice in excess of that required to fill pore spaces.

ice segregation—the process of formation of segregated ice by freezing of water in mineral or organic soil.

ice vein—an ice-filled crack or fissure in the ground. **NSIDC**

ice wedge—a massive, wedge-shaped body of ice in soil, usually with its apex pointing downwards, and composed of foliated, or layered, vertically-orientated (commonly white) ice. Wedges may be as much as several metres wide at the top, and penetrate the soil to a feather edge at depths of several metres. These may be "*active*" or "*inactive*" depending on whether or not these are growing by repeated, but not necessarily annual, winter cracking.

ice wedge cast—a filling of soil or sediment into the space formerly occupied by an ice wedge.

ice wedge polygon—any polygon surrounded by troughs underlain by ice wedges.

iciness—a qualitative term describing the quantity of ice in frozen ground. **NSIDC**

icing—a sheet-like mass of layered ice, formed either on the ground surface or on the surface of river or lake ice, by freezing of successive flows of water that may seep from the ground, flow from a spring or emerge from below river or lake ice through fractures. (**aufeis**, German; **naled**, Russian)

icing blister—a seasonal frost mound consisting of ice only and formed at least in part through lifting of one or more layers of icing by injected water. **NSIDC**

icing glade—an area which remains free of trees and shrubs due to annual occurrences of icings. **NSIDC**

icing mound—a seasonal frost mound consisting exclusively of thinly-layered ice, which has been formed by the freezing of successive flows of water. **NSIDC**

inactive ice wedge—an ice wedge that is no longer growing. **NSIDC**

inactive rock glacier—a mass of rock fragments and finer material on a slope that contains either an ice core or interstitial ice, and which shows evidence of past, but not present, movement. **NSIDC**

infiltration (of soil)—movement of water from the ground surface into soil.

in-situ—in its original place or environment.

interfacial water—water in transition layers at mineral/water and mineral/water/ice interfaces in frozen ground. **NSIDC**

intrapermafrost water—water occurring in unfrozen zones (that is, taliks and cryopegs) within permafrost. **NSIDC**

intrusive ice—ice formed from water intruded or injected under pressure into soils and rocks.

isoband cryogenic fabric—a distinct soil micromorphology, resulting from the processes of freezing and thawing, in which soil particles form subhorizontal layers of similar thickness. **NSIDC**

isolated cryopeg—a body of unfrozen ground, in which the temperature is perennially below 0°C, and which is entirely surrounded by perennially frozen ground. **NSIDC**

isolated talik—a layer or body of unfrozen ground entirely surrounded by perennially frozen ground. **NSIDC**

isotherm—a line on a chart that connects all points of equal or constant temperature.

kurum (Russian)**—**a general term for all types of coarse formations of broken rocks, on slopes of up to 40°, moving downslope mainly due to creep. **NSIDC**

lake talik—a layer or body of unfrozen ground occupying a depression in the permafrost table beneath a lake. **NSIDC**

latent heat of fusion—the amount of heat required to melt all the ice (or freeze all of the pore water) in a unit mass of soil or rock. **NSIDC**

lateral talik—a layer or body of unfrozen ground overlain and underlain by perennially frozen ground. **NSIDC**

latitudinal limit of permafrost—the southernmost latitude at which permafrost occurs in a lowland region of the northern hemisphere, or the northernmost latitude for the same in the southern hemisphere. **NSIDC**

latitudinal zonation of permafrost—the subdivision of a permafrost region into permafrost zones, based on the percentage of the area that is underlain by permafrost. **NSIDC**

layered cryostructure—the cryostructure of frozen silt or loam in which ice layers alternate with mineral layers that have a massive cryostructure. **NSIDC**

lens ice—ground ice occurring as lenses. **NSIDC**

lens-type cryostructure—the cryostructure of frozen silt or loam containing numerous ice lenses. **NSIDC**

loess—a buff-colored wind-blown deposit of fine silt.

long-term strength—the failure strength of a material after a long period of creep deformation. **NSIDC**

low-center polygon—an ice wedge polygon in which thawing of ice-rich permafrost has left the central area in a relatively depressed condition. **NSIDC**

macro-scale polygons—closed, multi-sided, roughly equi-dimensional, patterned ground features, commonly resulting from cracking of the ground due to thermal contraction. **NSIDC**

marine cryopeg—a layer or body of unfrozen ground, in which the temperature is perennially below 0°C, which forms part of coastal or sub-sea permafrost. **NSIDC**

mass wasting—downslope movement of soil or rock, on or near the ground surface, due to gravity.

massive-agglomerate cryostructure—the cryostructure of frozen silt or loam in which ice veins form an irregular three-dimensional network. **NSIDC**

massive cryostructure—the cryostructure of frozen ground in which all of the mineral particles are bonded together with ice.

massive ice—a comprehensive term used to describe large masses (at least 10 to 100 cm) of underground ice, including ice wedges, pingo ice, buried ice and dominantly horizontal ice beds. Massive ice beds typically have an ice content of at least 250 % (on an ice-to-dry-soil weight basis). If the ice content is less than 250 %, the beds are better termed "massive icy beds." Massive ice beds have a minimum thickness of 0.3 m. Some massive ice beds are more than 40 m thick and several kilometres in horizontal extent. Ice beds less than 0.3 m thick are better termed ice lenses.

massive-porous cryostructure—the cryostructure of frozen sand and gravel in which all of the mineral particles and bonder together with ice, but in which larger pore spaces are not completely filled with ice. **NSIDC**

mean annual ground surface temperature—the mean annual temperature of the surface of the ground. **NSIDC**

mean annual ground temperature—the mean annual temperature of the ground at a particular depth. **NSIDC**

mechanical properties of frozen ground—these include the static and dynamic properties relating to the strength and deformability of frozen geological materials: the compressive and shearing strengths, with and without confinement; the static and dynamic Young' Modulus and Poisson's ratio; the velocities of compressional and shear waves; seismic velocities.

mechanical strength—the failure strength of a material under given loading conditions. **NSIDC**

micro-scale polygon—closed, multi-sided, roughly equidimensional, pattern ground usually caused by desiccation cracking of fine-grained soils. The polygons are less than 2 m in diameter. **NSIDC**

minerogenic palsa—a palsa in which the core extends below the peat into the underlying material. **NSIDC**

mountain permafrost—permafrost existing at high altitudes, regardless of latitude.

mud circle—a type of nonsorted circle developed in fine-grained materials. **NSIDC**

multiple retrogressive slide—a type of mass movement associated with shear failure in unfrozen sediments underlying permafrost, leading to detachment of blocks of frozen ground that move downslope. This type of slide is not unique to frozen geological materials and may also occur in non-permafrost conditions. **NSIDC**

n-factor—the ratio of the surface freezing or thawing index to the air freezing or thawing index. **NSIDC**

needle ice—thin, elongated, crystals of ice that form perpendicular to the surface of the ground. **NSIDC**

noncryotic ground—geological materials at temperatures above 0°C. **NSIDC**

non-frost-susceptible soil—a soil that does not display significant detrimental ice segregation during freezing.

nonsorted circle—a form of patterned ground that is equidimensional in several directions with a dominantly circular outline which lacks a border of stones. **NSIDC**

nonsorted net—a type of patterned ground with cells that are equi-dimensional in several directions, but neither circular nor polygonal, and lacking borders of stones. **NSIDC**

nonsorted polygon—a type of patterned ground that is equidimensional in several directions, with a dominant polygonal outline, and lacking a border of stones. **NSIDC**

nonsorted step—a type of patterned ground with a step-like form and a downslope border of vegetation embanking an area of relatively bare ground upslope. **NSIDC**

nonsorted stripe—a type of patterned ground with a striped and nonsorted appearance, which is due to parallel strips of vegetation-covered ground and intervening strips of relatively bare ground, and orientated down the steepest available slope. **NSIDC**

onshore permafrost—permafrost beneath exposed land surfaces. **NSIDC**

open-cavity ice—ice formed in an open cavity or crack in the ground by reverse sublimation of water vapor. **NSIDC**

open-system freezing—freezing that occurs under conditions in which water can be gained or lost by the system. **NSIDC**

open-system pingo—a pingo formed by doming of frozen ground due to the freezing of injected water supplied by groundwater moving downslope through taliks to the site of the pingo, where it move to the surface. **NSIDC**

open talik—a body of unfrozen ground that penetrates the permafrost completely.

orbicular cryogenic fabric—a distinct soil micromorphology resulting from the effects of freezing and thawing, in which coarser soil particles form circular to ellipsoidal patterns. **NSIDC**

organic cryosol—an organic soil having a surface layer containing more than 17 % organic carbon by weight, with permafrost within 1 m below the surface. **NSIDC**

oriented lake—one of a group of lakes possessing a common, preferred, long-axis orientation. **NSIDC**

orthel—a suborder of gelisol that contains neither large quantities of organic matter (as in histels), nor evidence of extensive mixing due to frost action (as in turbels). **USDA**

paleosol—an ancient soil or soil horizon that formed on the earth's surface during the geologic past.

palsa—a peaty permafrost mound possessing a core of alternating layers of segregated ice and peat or mineral soil material. **NSIDC**

palsa bog—a poorly-drained lowland underlain by organic-rich sediments, which contains perennially frozen peat bodies (peat plateaux) and occasionally palsas. **NSIDC**

partially-bonded permafrost—ice-bearing permafrost in which some of the soil particles are not bonded together by ice. **NSIDC**

passive construction methods in permafrost—methods of construction through which the foundation materials are maintained in the frozen state.

passive single-phase thermal pile—a foundation pile provided with a single-phase natural convection cooling system to remove heat from the ground. **NSIDC**

passive two-phase thermal pile—a foundation pile provided with a two-phase natural convection cooling system to remove heat from the ground. **NSIDC**

patterned ground—a general term for any ground surface exhibiting a discernibly ordered, more or less symmetrical, structural pattern of ground and, where present, vegetation. **NSIDC**

peat—an unconsolidated, compressible soil consisting of partially decomposed semi-carbonized remains of plants, some animals, and soil material. Peat, found in ancient bogs, can be the first stage in the formation of coal.

peat hummock—a hummock consisting of peat. **NSIDC**

peat plateau—a generally flat-topped, expanses of peat rising one or more meters above the general surface of a peatland (or, peat bog). In a peat plateau, a layer of permafrost exists. This may penetrate into the peat below and farther, into the underlying mineral soil.

peatland—peat-covered terrain.

percolation—the movement of water downward and radially through subsurface soil layers.

pereletok (Russian)**—**a layer of frozen ground which forms part of the seasonally frozen ground, in areas either free of permafrost or with a lowered permafrost table, which remains frozen through one or several summers, and then thaws. **NSIDC**

perennially frozen ground—see **permafrost**.

pergelic soil temperature regime—in United States Department of Agriculture (USDA) classification, these are soils in which the mean annual temperature is less than 0°C (32°F). Ice wedges and lenses are normal in such soils in the United States.

periglacial—the conditions, processes, and landforms associated with cold non-glacial environments. **NSIDC**

periglacial phenomena—landforms and soil characteristics produced by periglacial processes. **NSIDC**

periglacial processes—processes associated with frost action in cold, non-glacial environments. **NSIDC**

permacrete—an artificial mixture of frozen soil materials cemented by pore ice, which forms a concrete-like construction material for use in cold regions. **NSIDC**

permafrost—the thermal condition in which the temperatures in earth materials remain below 0°C (32°F) for at least two consecutive winters and the intervening summer; moisture in the form of water and ground ice may or may not be present.

permafrost aggradation—an increase in the thickness and/or area of permafrost through natural or artificial causes as a result of climatic cooling and/or change of terrain conditions such as vegetation succession, filling of lake basins, or human activity.

permafrost base—the lower boundary surface of permafrost, above which temperatures are below 0°C (32°F), and below which temperatures are above 0°C (32°F).

permafrost boundary—*(1)* the geographical boundary between the continuous and discontinuous permafrost zones; *(2)* the margin of a discrete body of permafrost. **NSIDC**

permafrost degradation—a decrease in thickness and/or areal extent of permafrost because of natural or artificial causes as a result of climatic warming and/or change of terrain conditions such as disturbance or removal of an insulating vegetation layer by fire or human means.

permafrost limit—the geographical distal (terminal) boundaries of the circumpolar, or alpine, or altitudinal, continuous and discontinuous permafrost zones.

permafrost region—a region in which the temperature of some or all of the ground beneath the layer which freezes and thaws seasonally remains at or below 0°C for at least two consecutive years.

permafrost, relict—see **relict permafrost**.

permafrost, saline—see **saline permafrost**.

permafrost table—the upper boundary surface of permafrost.

permafrost thickness—the vertical distance between the permafrost table and the permafrost base.

permafrost zone—a major subdivision of a permafrost region. **NSIDC**

pingo—a perennial frost mound consisting of a core of massive ice, produced primarily by injection of water, and covered with soil and vegetation. **NSIDC**

pingo ice—massive ice which forms the core of a pingo. **NSIDC**

pingo remnant—a collapsed pingo. **NSIDC**

pingo scar—a pingo remnant in a contemporary non-permafrost environment. **NSIDC**

planetary permafrost—permafrost occurring on any of the planetary bodies.

plastic frozen ground—fine-grained soil in which only a portion of the pore water has turned into ice. **NSIDC**

Poisson's ratio—the absolute value of the ratio between linear strain changes, perpendicular to and in the direction of a given uniaxial stress change, respectively. **NSIDC**

polygon—a type pf patterned ground consisting of a closed, roughly equi-dimensional, figure bounded by several sides, commonly more-or-less straight, but some, or all, of which may be irregularly curved. A polygon may be either a "low center" or a "high center," depending on whether its center is lower or higher than its margins.

polygon trough—the narrow depression surrounding a high-center polygon. **NSIDC**

polygonal pattern—a pattern of numerous multi-sided, roughly equi-dimensional figures, bounded by more-or-less straight lines. **NSIDC**

polygonal peat plateau—a peat plateau with ice wedge polygons. **NSIDC**

poorly bonded—a condition in which the soil particles are weakly held together by the ice, so that the frozen soil has poor resistance to chipping and breaking.

poorly-bonded permafrost—ice-bearing permafrost in which few of the soil particles are bonded together by ice. **NSIDC**

pore ice—ice occurring in the pores of earth materials.

pore water—water occurring in the pores of earth materials. **NSIDC**

porous ice—ice that contains numerous voids, usually interconnected and usually resulting from melting at air bubbles or along crystal interfaces from presence of salt or other materials in the water, or from the freezing of saturated snow. Though porous, the mass retains its structural unity.

pressure melting—lowering of the melting point of ice through the application of pressure.

reconstituted sample—a sample of frozen ground which has been permitted to thaw before being refrozen for the performance of mechanical and other tests.

relative permittivity—the relative permittivity of a soil is the ratio of the permittivity of the soil to the permittivity of a vacuum. It is also known as the **dielectric constant**. **NSIDC**

relict active layer—a layer of ground, now perennially frozen, lying immediately below the modern active layer. Its thickness indicates the greater annual depth of thaw that occurred during a previous warmer climatic period. **NSIDC**

relict ice—ice formed in, and remaining from, the recent geological past. **NSIDC**

relict permafrost—permafrost that reflects past climatic conditions differing from those of today, and which must have formed when the ground surface temperature was different than it is now, as these are not in thermal equilibrium with the present mean annual ground surface temperature.

residual stress—the effective stress generated in a thawing soil if no change of volume is permitted during the thaw. **NSIDC**

residual thaw layer—a layer of thawed or unfrozen ground between seasonally frozen ground and the permafrost table.

reticulate-blocky cryostructure—the structure of frozen soils in which horizontal and vertical veins of ice form a three-dimensional, irregular rectangular lattice. **NSIDC**

reticulate cryostructure—the structure of frozen soils in which horizontal and vertical veins of ice form a three-dimensional rectangular or square lattice. **NSIDC**

reticulate(d) ice—a network of horizontal or vertical ice veins forming a three-dimensional rectangular lattice within frozen fine-grained sediments.

retrogressive thaw slump—a slope failure resulting from thawing of ice-rich permafrost. It consists of a steep headwall, containing ice or ice-rich sediment, which retreats in a retrogressive manner through melting, and a debris flow formed from the retrogressive thawed sediment and ice, which slides down from the face of the headwall to its base.

river talik—a layer or body of unfrozen ground occupying a depression in the permafrost table beneath a river. **NSIDC**

rock glacier—a mass of rock fragments and finer material on a slope, that contains either interstitial ice or an ice core, and shows evidence of past or present movement. **NSIDC**

saline permafrost—permafrost in which part or all of the total water content is unfrozen because of freezing-point depression caused by the dissolved solids content of the pore water. **NSIDC**

salinity—*(1)* a general property of aqueous solutions caused by the alkali, alkaline, earth, and metal salts that are not hydrolyzed; *(2)* the ratio of the weight of salt in a soil sample to the total weight of the sample. **NSIDC**

sand wedge—a wedge-shaped body of sand produced by the filling of a thermal contraction crack with sand that has either been blown in or washed in. **NSIDC**

sand-wedge polygon—a polygon outlined by sand wedges underlying its boundaries. **NSIDC**

seasonal freezing index—the cumulative number of degree-days below 0°C, calculated as the arithmetic sum of all the negative and positive mean daily air temperatures (degrees C) for a specific station during the period between the highest point in the fall and the lowest point the following spring, on the cumulative degree-day time curve. **NSIDC**

seasonal frost—*(1)* seasonal temperatures causing frost that affect earth materials and keep these frozen only during the winter; *(2)* the occurrence of ground temperatures below 0°C for only part of the year. **NSIDC**

seasonal thawing index—the cumulative number of degree-days above 0°C, calculated as the arithmetic sum of all the positive and negative mean daily air temperatures (degrees C) for a specific station during the period between the lowest point in the spring and the highest point the following fall, on the cumulative degree-day time curve. **NSIDC**

seasonally-active permafrost—the uppermost layer of the permafrost which undergoes seasonal phase changes due to the lowered thawing temperature and freezing-point depression of its pore water. **NSIDC**

seasonally frozen ground—ground that freezes annually.

seasonally frozen layer—the "active layer" in areas without permafrost. **NSIDC**

seasonally thawed ground—ground that thaws annually.

seasonally thawed layer—the "active layer" in areas of permafrost. **NSIDC**

segregated ice—ice formed by the migration of pore water to the freezing plane where it forms into discreet lenses, layers, or seams, ranging in thickness from hairline to greater than 10 m (32 ft). The ice is formed by **ice segregation**.

segregation potential—the ratio of the rate of moisture migration to the temperature gradient in a frozen soil, near the 0°C isotherm. **NSIDC**

shear strength—the maximum resistance of a soil or rock to shearing stresses. **D653**

short-term strength—the failure strength of a material under a short-term loading (that is, up to about 10 min in a uniaxial compression test). **NSIDC**

sill ice—ice in a concordant tabular mass, formed by water intruded or injected under pressure into porous earth material.

single-phase thermosyphon—a passive heat transfer device, filled with a liquid or a gas, installed to remove heat from the ground. **NSIDC**

snow—ice crystals precipitated from the atmosphere, mainly in complex hexagonal form, and often agglomerated into snowflakes. **NSIDC**

snowcover—the accumulation of fallen snow. **NSIDC**

snowdrift—an accumulation of wind-blown snow, often much thicker than the surrounding snowcover. **NSIDC**

snowline—the boundary of a highland region in which snow never melts. **NSIDC**

snowmelt—*(1)* melting of the snowcover; *(2)* the period during which the melting of the snowcover occurs at the end of winter. **NSIDC**

snowpatch—a relatively small area of snowcover, remaining after the snowmelt period. **NSIDC**

soil wedge—a wedge-shaped, downward-tapering, body of soil different in structure from the surrounding soil, which may be an ice wedge cast or produced by repeated frost cracking and filling with soil where no ice wedge was ever present.

solifluction—the process of slow, gravitational, down-slope movement of saturated, non-frozen earth material behaving as a viscous mass over a surface of frozen material. Solifluction features lobes, stripes, sheets, and terraces.

solifluction apron—a fan-like deposit at the base of a slope, produced by solifluction. **NSIDC**

solifluction features—geomorphological features, of varying scale, produced by the process of solifluction. These include: aprons, lobes, sheets, and terraces. **NSIDC**

solifluction lobe—an isolated tongue-shaped solifluction feature formed by rapid solifluction on certain sections of a slope which exhibit variations in gradient. It is to be noted that the NSDIC definition includes dimensions of up to 25 m wide and 150 m or more long.

solifluction sheet—a broad deposit of non-sorted, water-saturated, locally derived materials that is moving, or has moved, downslope. **NSIDC**

solifluction terrace—a low step, or bench, with a straight or lobate front, the latter reflecting local differences in the rate of solifluction movement. **NSIDC**

sorted circle—a form of patterned ground that is equi-dimensional in several directions, with a dominantly circular outline, and a sorted appearance commonly due to a border of stones surrounding a central area of finer material. **NSIDC**

sorted net—a form of patterned ground with cells that are equi-dimensional in several directions, neither dominantly circular nor polygonal, and with a sorted appearance commonly due to borders of stones surrounding central areas of finer material. **NSIDC**

sorted polygon—a form of patterned ground that is equi-dimensional in several directions, with a dominantly polygonal outline, and a sorted appearance commonly due to a border of stones surrounding a central area of finer material. **NSIDC**

sorted step—a form of patterned ground with a step-like form and a downslope border of stones embanking on an area of relatively fine-grained bare ground upslope. **NSIDC**

sorted stripe—a form of patterned ground with a striped and sorted appearance due to parallel strips of stones and intervening strips of finer material, oriented down the steepest available slope. **NSIDC**

specific heat capacity—the amount of heat required to raise the temperature of a unit mass of a substance by one degree. It is commonly expressed in Joules per kg per degree K. **NSIDC**

sporadic permafrost—a subzone of the zone of discontinuous permafrost: *(1)* in North American usage: permafrost underlying <30 % of the exposed land surface; *(2)* in Russian usage: permafrost underlying from 3 to 20 % of the exposed land surface. **GPRGIT; Permafrost Map of the USSR, 1996**

static cryosol—a mineral soil showing little or no evidence of cryoturbation, with permafrost within 1 m below the surface. **NSIDC**

stone-banked (solifluction) lobe—a solifluction lobe with a stony front. **NSIDC**

stone-banked (solifluction) terrace—a solifluction terrace with a stony front. **NSIDC**

stone garland—the downslope border of stones along a sorted step, embanking an area of relatively fine-grained bare ground upslope. **NSIDC**

stony earth circle—a type of nonsorted circle developed in gravelly materials. **NSIDC**

strength, adfreeze—see **adfreeze strength**.

string fen—a peatland with roughly parallel narrow ridges of peat dominated by fenlike vegetation interspersed with slight depressions, many of which containing shallow pools. **NSIDC**

subglacial permafrost—permafrost beneath a glacier. **NSIDC**

subglacial talik—a layer or body of unfrozen ground beneath a glacier in an area with permafrost. **NSIDC**

sublimation—the process of converting ice in the solid state directly into water vapor (as through the action of wind).

sublimation ice—ice formed by reverse sublimation of water vapor onto cold surfaces. **NSIDC**

submarine (subsea) permafrost—permafrost occurring beneath the sea or ocean bottom.

subpermafrost water—free water in the ground below the permafrost base.

subsea talik—a layer or body of unfrozen ground beneath the seabottom and forming part of the subsea permafrost. **NSIDC**

supercooling—cooling of a liquid to a temperature below its freezing point, without causing solidification. **NSIDC**

suprapermafrost water—free water in the ground above the permafrost.

surface freezing index—the cumulative number of degree-days below 0°C for the surface temperature of the ground, or other surface on the ground, during a given period.

surface thawing index—the cumulative number of degree-days above 0°C for the surface temperature of the ground, or other surface on the ground, during a given period.

suscitic cryogenic fabric—a distinct soil micromorphology resulting from the effects of freezing and thawing, in which coarser soil particles have vertical or near-vertical orientation. **NSIDC**

syngenetic ice—*(1)* ground ice that formed more-or-less simultaneously with the deposition of the ground in which it occurs; *(2)* ground ice developed during the formation of syngenetic permafrost. **NSIDC**

syngenetic ice wedge—an ice wedge formed during the formation of syngenetic permafrost; that is, formed more or less simultaneously with the deposition of the earth materials in which it occurs. **NSIDC**

syngenetic permafrost—*(1)* permafrost that formed more-or-less simultaneously with the deposition of the ground in which it occurs; *(2)* permafrost that formed through a rise of the permafrost table during the deposition of additional sediment or other earth material on the ground surface. **NSIDC**

talik—*(1)* a layer or body of unfrozen ground within the permafrost. It may be either a "*closed* " or "*open*" talik, depending on whether it is or is not entirely surrounded by permafrost; *(2)* a layer or body of unfrozen ground occurring in a permafrost area due to a local anomaly in thermal, hydrological, hydrogeological, or hydrochemical conditions. **NSIDC**

temperature profile—the graphical or analytical expression of the variation in ground temperature with depth. **NSIDC**

tension cracked ice—ice, banded or layered, which forms in cracks produced by tension or mechanical rupture of the ground, resulting mainly from the growth of segregated or intrusive ice.

thaw basin—a depression of the permafrost table created by natural or artificial thawing.

thaw bulb—a more-or-less symmetrical area of thaw in permafrost surrounding a man-made structure on or in permafrost and maintained at temperatures above 0°C. **NSIDC**

thaw consolidation—*(1)* the process by which a reduction in volume and increase in density of a soil mass occurs, following thaw, in response to the escape of water under the weight of the soil itself and/or an applied load; *(2)* the process by which settlement due to thaw (settlement) is impeded by flow of water from the soil. Thaw consolidation may proceed for many years.

thaw consolidation ratio—a dimensionless ratio describing the relationship between the rate of thaw and the rate of consolidation of a thawing soil, which is considered to be a measure of the relative rates of generation and expulsion of excess water during thaw. **NSIDC**

thaw penetration—the downward movement of the thawing front during the thawing of frozen ground. **NSIDC**

thaw-sensitive permafrost—perennially frozen ground which, upon thawing, will experience significant thaw settlement and suffer loss of strength to a value significantly lower than that for similar material in an unfrozen condition. **NSIDC**

thaw settlement—the generally differential downward movement of the ground surface resulting from escape of water on melting of excess ice in the soil and the thaw consolidation of the soil mass.

thaw sink—a closed thaw basin with subterranean drainage. **NSIDC**

thaw slumping—a type of mass movement caused by the conversion of ice into water in a soil by ground thaw, creating the kind of landslide that most closely resembles the more temperate climate earth flow with a well-developed breakaway scarp front.

thaw stable permafrost—perennially frozen soils that do not, on thawing, show loss of strength below normal long-time thawed values, or result in ground settlement.

thaw strain—the amount that frozen ground compresses upon thawing.

thaw unconformity—a boundary sometimes identified in perennially frozen ground, which represents the base of a relict active layer as well as the corresponding earlier permafrost table. **NSIDC**

thaw unstable permafrost—perennially frozen soils that show, on thawing, a significant loss of bearing strength, or below normal, long-time thawed values, and/or significant grounds settlement, as a direct result of the melting of the excess ice in the soil.

thaw weakening—the reduction in shear strength due to the decrease in effective stresses resulting from the generation and slow dissipation of excess pore pressures when frozen soils containing ice are thawing. **NSIDC**

thawed ground—previously frozen ground in which all of the ice has melted.

thawing (of frozen ground)—the melting of the ice in frozen ground, usually as the result of an increase in temperature. **NSIDC**

thawing front—the advancing boundary between thawed ground and frozen ground.

thawing index—the number of degree-days between 0°C (32°F) and the mean temperature each day on the cumulative degree-day time curve for one thawing season. The **air thawing index** is determined from temperatures measured about 1.4 m (4.5 ft) above the ground surface, while that determined from temperatures measured at, or immediately below, a surface is known as the **surface thawing index**.

thermal conductivity—the quantity of heat that will flow through a unit area of a substance in unit time under a unit temperature gradient . It is commonly expressed in joules per second per meter per degree K. **NSIDC**

thermal contraction crack—a tensile fracture resulting from thermal stresses in frozen ground. **NSIDC**

thermal-contraction-crack ice—ice formed in thermal contraction cracks in the ground. **NSIDC**

thermal diffusivity—the ratio of the thermal conductivity to the volumetric heat capacity. **NSIDC**

thermal erosion—the erosion of ice-rich permafrost by the combined thermal and mechanical action of moving water or air (sublimation).

thermal expansion (or contraction) coefficient—the volume change per unit volume of a substance due to a one degree change in its temperature. **NSIDC**

thermal pile(s)—structural piling modified to passively remove heat from the ground whenever the ambient air temperature is lower than the ground temperature. See: thermopiles, thermoprobe, thermosyphon, thermo tube.

thermal properties of frozen ground—the properties of the ground governing the flow of heat through it, and its freezing and thawing conditions. These include: thermal conductivity, heat capacity (specific heat), and the latent heat of fusion. **NSIDC**

thermal regime of the ground—a general term encompassing the temperature distribution and heat flows in the ground and their dependence upon time. **NSIDC**

thermal talik—a layer or body of unfrozen ground in a permafrost area in which the temperature is above 0°C due to the local thermal regime of the ground. **NSIDC**

thermal-erosional cirque—the unusually steep horseshoe-shaped headwall of a retrogressive thaw slump. **NSIDC**

thermal-erosional niche—a recess at the base of a river bank or coastal bluff produced by thermal erosion of ice-bonded permafrost. **NSIDC**

thermokarst—*(1)* karst topography (areas of depression and/or subsidence) resulting from the thawing of ice-rich permafrost or massive ice; *(2)* the process by which characteristic landforms result from the thawing of ice-rich permafrost.

thermokarst lake—a lake occupying a closed depression formed by settlement of the ground following the thawing of ice-rich permafrost or the melting of massive ice. **NSIDC**

thermokarst mound—a hummock remaining after melting of the ice wedges surrounding an ice-wedge polygon. **NSIDC**

thermokarst terrain—the often irregular topography resulting from the melting of excess ground ice and subsequent thaw settlement. **NSIDC**

thermopile—a trade name for a load-carrying piling that is a thermosyphon. The pile shell is used to contain the thermosyphon working fluid.

thermoprobe—a trade name for a thermosyphon that is not a load-carrying piling.

thermosyphon—a two-phase, passive, heat transfer device that removes heat from the ground whenever the ambient air temperature is lower than the ground temperature. Liquid in the lower end of the thermosyphon evaporates by absorbing thermal energy from the ground. Vapor condenses in the upper end of the thermsyphon that is exposed to the air. Condensate return to the lower end is by gravity.

thermo tube—a trade name for a convection tube.

thufur (Icelandic)**—**perennial hummocks formed in either the active layer of permafrost areas, or in the seasonally frozen

ground in non-permafrost areas during freezing of the ground (singular thufa). **NSIDC**

total annual freezing index—the cumulative number of degree-days, calculated by adding all of the negative mean daily air temperature (in degrees C) for a specific station during a calendar year. **NSIDC**

total annual thawing index—the cumulative number of degree-days, calculated by adding all of the positive mean daily air temperature (in degrees C) for a specific station during a calendar year. **NSIDC**

total water content (of frozen ground)—the total amount of water (water and ice) contained in soil or rock. This may be determined: *(1)* on a dry weight basis, as the ratio of the mass of the water and ice to the dry mass of the sample, expressed as a percentage; *(2)* on a volume basis, as the ratio of the volume of water and ice to the volume of the entire sample, expressed as a percentage. Using the volumetric method, the ratio cannot exceed unity. In the gravimetric method, however, it can.

transient talik—a layer or body of unfrozen ground in a permafrost area that is being eliminated gradually by freezing. **NSIDC**

tundra—treeless terrain with a continuous cover of vegetation, found at both high latitudes and high altitudes. **NSIDC**

turbel—a suborder of gelisol that displays evidence of extensive mixing due to the action of frost (cryoturbation). **USDA**

turbic cryosol—a mineral soil showing marked evidence of cryoturbation, as evidenced by broke horizons and displaced material. **NSIDC**

turf-banked (solifluction) lobe—a solifluction lobe with its front covered by a vegetation mat. **NSIDC**

turf-banked (solifluction) terrace—a solifluction terrace with its front covered by a vegetation mat. **NSIDC**

turf hummock—a hummock consisting of organic and vegetation matter with or without a core of mineral soil or stones. **NSIDC**

two-layer permafrost—ground in which two layers of permafrost are separated by a layer of unfrozen ground. **NSIDC**

two-phase thermosyphon—a passive heat transfer device, filled with a temperature-dependent liquid/vapor combination, installed to remove heat from the ground. **NSIDC**

undisturbed sample—a sample of frozen ground which has been maintained at a constant temperature in the frozen state, as close as possible to that which existed in-situ when the sample was obtained, for purposes of performing mechanical and other tests.

unfrozen ground—ground that does not contain any ice. **NSIDC**

unfrozen water content—the ratio, expressed as a percentage, of either *(1)* the weight of unfrozen water to the weight of dry soil, or *(2)* the volume of the unfrozen water to the total volume of the sample. **NSIDC**

upward freezing—the advance of the freezing front upwards from the permafrost table during annual freezing of the active layer. **NSIDC**

vadose zone—the region between the ground surface and underlying groundwater aquifers. It is the region through which pollutants and contaminants travel before entering the groundwater.

vein ice—*(1)* a comprehensive term for ice formed along cracks, where it occurs in bodies of various shapes, including tabular forms and wedges; *(2)* a seam or vein of ice occupying a crack that cuts across rock or soil layers.

volumetric heat capacity—the amount of heat required to raise the temperature of a unit volume of a substance by one degree. **NSIDC**

volumetric latent heat of fusion—the amount of heat required to melt all of the ice (or to freeze all of the pore water) in a unit volume of soil or rock. **NSIDC**

volumetric (total) water content—the ratio of the volume of the water and ice in a sample to the volume of the whole sample, expressed either as a fraction or as a percentage. **NSIDC**

water content, unfrozen—see **unfrozen water content**.

waterbody encircling a palsa—a water-filled depression surrounding a palsa. **NSIDC**

wedge ice—the ice occurring in an ice wedge. **NSIDC**

well bonded permafrost—a condition in which the soil particles are strongly held together by the ice, so that the frozen soil possesses relatively high resistance to chipping or breaking.

widespread permafrost—widely distributed, discontinuous permafrost.

Young's modulus—the ratio of the increase of stress acting on a test sample to the resulting increase in strain, under constant transverse stress. **NSIDC**

zero curtain—the period during which a nearly constant temperature, very close to the freezing point, exists during annual freezing and, occasionally, thawing, of the active layer. The zone immediately above the permafrost table where zero temperature (°C) exists for a considerable period during freezing and thawing of the overlying ground.

zone of gas-hydrate stability—that portion of the subsurface where the conditions of temperature and pressure are suitable for the formation and preservation of gas hydrates. **NSIDC**

5. Symbols

5.1 Symbols relating to soil and rock mechanics, as developed by the International Society for Rock Mechanics (ISRM) are listed in Terminology D653. In this document reference is

made to both the English System of units (for example, degrees Fahrenheit, feet) and the International System of units (for example, degrees Celsius (or, Centigrade), meters).

6. Keywords

6.1 frozen rock; frozen soil; frozen water; terminology; terms