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Ice in Canadian Caves

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Caves are widespread in Canada where, because of the prevailing cool-to-cold climates, most will develop at least some conventional dripstone ice stalactites and stalagmites, etc. in the entrance zones during the later fall and the winter. All other types of cave ice described in the literature are to be found also, although relatively few examples of the classical glacière (sensu Balch (1900) – large accumulations of firn in deep entrances, converted to polycrystalline glacier ice by regelation) are known. The greatest variety of forms, spatial and temporal distributions, within caves occur in the western mountain ranges. In the Rockies, Selkirks and other ranges below Lat. 60o N, Coulthard Cave, Nakimu Caves and many others contain perennial ice masses in both static and dynamic air flow settings, with the ice extending beyond entrance seasonally chilled zones into the deep interior. Several examples are known with spectacular displays of giant hexagonal hoarfrost crystals as at the well-known Kungur Cave (Ural Mountains, Russia), or of extruded ice mimicking the 'gypsum flowers' known in warmer caves. Castleguard Cave is blocked by intruded glacier ice where its upstream galleries terminate beneath the Columbia Icefield, the largest remaining glacier in the Rocky Mountains; a 1000 m long cold zone at the downstream entrance accumulates thick ice and hoarfrost deposits each winter, which are then destroyed by summer floods.
North of Lat. 60o N permafrost becomes widespread to continuous in the mountains and plateaus. In the Nahanni Karst (Lat. 61o N) and Dodo Karst (Lat. 66o N) in the remote Mackenzie Mountains large numbers of relict caves become completely blocked by fillings of regelated hoarfrost or by permafrozen clastic sediments with pipkrake . Grotte Valerie (Nahanni) is a model for dynamic cold caves, with an upper entrance 'warm zone' (+1 to +2o C) where the bedrock is thawed and small calcite speleothems are precipitated, a lower interior zone of hoarfrost and dripstone ice deposition, and a lowest permafrozen zone that is dry and dusty. From nearly forty years of observation it is apparent to the author that global warming is impacting these regions quite strongly, with net ablation of perennial cave ice and frequent landslides of thawing glacial deposits into karst sinkholes. In contrast, at Nanisivik (a former zinc/lead mine in paleokarst at 75o N on Baffin Island) a karst-collapse mega-breccia in dolomite along the south side of the mineral deposit is now firmly cemented by massive ground ice: when covered by 500+ m of glacier ice during the Last (Würm) Glaciation the permafrost thawed and sub-glacial melt water was injected into the dolomite to induce the collapse.