

Understanding trends in research on permafrost and geocryological hazards in Nunatsiavut, Labrador, northeastern Canada



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REVIEWED LITERATURE

- Allard, M., Lemay, M., Barrette, C., L'Hérault, E., Sarrazin, D., Bell, T., and Doré, G. 2012. Permafrost and climate change in Nunavik and Nunatsiavut: Importance for municipal and transportation infrastructures. *In* Nunavik and Nunatsiavut: From science to policy. An Integrated Regional Impact Study (IRIS) of climate change and modernization. pp. 171–197.
- Allard, M., and Séguin, M.K. 1984. Le pergélisol au Québec nordique : bilan et perspectives. *Géographie physique et Quaternaire*, **41**(1): 141–152. doi:10.7202/032671ar.
- Anderson, D., Ford, J.D., and Way, R.G. 2018. The Impacts of Climate and Social Changes on Cloudberry (Bakeapple) Picking: A Case Study from Southeastern Labrador. *Human Ecology*, **46**(6): 849–863. doi:10.1007/s10745-018-0038-3.
- Andrews, J.T. 1961. Permafrost in southern Labrador-Ungava. *Canadian Geographies / Géographies canadiennes*, **5**(3): 34–35. doi:10.1111/j.1541-0064.1961.tb01417.x.
- Beer, J., Wang, Y., Way, R., Forget, A., and Colyn, V. 2024. Uncrewed Aerial Vehicle–Based Assessments of Peatland Permafrost Vulnerability Along the Labrador Sea Coastline, Northern Canada. *Permafrost and Periglacial Processes*, **35**(4): 461–477. doi:10.1002/ppp.2242.
- Belcher, D.J. 1949. The use of aerial photographs for pre-determining ground conditions in the Arctic and Subarctic regions of North America.
- Bell, T., Putt, M., and Sheldon, T. 2011. Landscape hazard assessment in Nain, Phase 1: Inventory of surficial sediment types and infrastructure damage. Technical report, Nunatsiavut Government.
- Brown, R.J. 1979. Permafrost distribution in the southern part of the discontinuous zone in Quebec and Labrador. *Géographie physique et Quaternaire*, **33**(3–4): 279–289.
- Brown, R.J.E. 1975. Permafrost investigations in Quebec and Newfoundland (Labrador). *In* Technical Paper (National Research Council of Canada. Division of Building Research). National Research Council of Canada.
- Canadian Environmental Assessment Agency. 2018. Environmental assessment report for Howse Property Iron Mine Project. Impact Assessment Agency of Canada
- Davis, E., Trant, A., Hermanutz, L., Way, R.G., Lewkowicz, A.G., Siegwart Collier, L., Cuerrier, A., and Whitaker, D. 2021. Plant–Environment Interactions in the Low Arctic Torngat Mountains of Labrador. *Ecosystems*, **24**(5): 1038–1058. doi:10.1007/s10021-020-00577-6.
- Desrochers, D.T., and Granberg, H.B. 1988. Schefferville snow-ground interface temperatures. *In* Proceedings of the 5th International Conference on Permafrost. Trondheim, Norway. pp. 67–72.
- de Vernal, A., Mathieu, C., and Gangloff, P. 1983. Analyse stratigraphique d'un lobe de gélifluxion des Torngats Centrales, Labrador. *Géographie physique et Quaternaire*, **37**(2): 205–210. doi:10.7202/032515ar.
- Dionne, J.-C. 1984. Pales et limite méridionale du pergélisol dans l'hémisphère nord: le cas de Blanc-Sablon, Québec. *Géographie physique et Quaternaire*, **38**(2): 165–184. doi:10.7202/032550ar.
- Dionne, J.-C., and Richard, P.J.H. 2006. Origine, Age et taux d'accrétion verticale de la tourbière pales de Blanc-Sablon, basse Côte-Nord, Golfe du Saint-Laurent, Québec. *Géographie physique et Quaternaire*, **60**(2): 199–205. doi:10.7202/016829ar.
- Doolittle, J.A., Hardisky, M.A., and Black, S. 1992. A Ground-Penetrating Radar Study of Goodream Palsas, Newfoundland, Canada. *Arctic and Alpine Research*, **24**(2): 173–178. doi:10.2307/1551537.
- Elias, S.A. 1982. Paleoenvironmental Interpretation of Holocene Insect Fossils from Northeastern Labrador, Canada. *Arctic and Alpine Research*, **14**(4): 311. doi:10.2307/1550794.
- Environment Canada. 1999: Audio Tape Transcript of the East Central Labrador Ecological Land Survey, https://ftp.maps.canada.ca/pub/nrcan_rncan/archive/vector/labrador/.
- Evans, D.J.A., and Rogerson, R.J. 1988. A radiocarbon-dated gelifluxion lobe in the Nachvak Fiord area, northern Labrador, Canada. *Earth Surface Processes and Landforms*, **13**(7): 657–662. doi:10.1002/esp.3290130708.
- Forget, A., Way, R., Wang, Y., Beer, J., Colyn, V., Tutton, R., Trant, A., and Hermanutz, L. 2024. Evaluating local drivers of ground surface temperature variability in coastal Labrador. *Canadian Permafrost Association*, Whitehorse, Yukon, Canada. pp. 94–102.

- Garg, O.P. 1979. Mining of frozen iron ore in northern Québec and Labrador. *Géographie physique et Quaternaire*, **33**(3–4): 369–376. doi:10.7202/1000371ar.
- Granberg, H.B. 1973. Indirect mapping of the snowcover for permafrost prediction at Schefferville, Québec. *In* Proceedings of the 2nd International Conference on Permafrost. Washington, USA. pp. 113–120.
- Granberg, H.B. 1988. On the spatial dynamics of snowcover - permafrost relationships at Schefferville. *In* Proceedings of the 5th International Conference on Permafrost. Trondheim, Norway. pp. 159–164.
- Granberg, H.B. 1989. Permafrost mapping at Schefferville, Québec. *Physical Geography*, **10**(3): 249–269.
- Granberg, H.B. 1994. Mapping heat loss zones for permafrost prediction at the northern/alpine limit of the Boreal Forest using high-resolution C-Band SAR. *Remote sensing of environment*, **50**(3): 280–286.
- Granberg, H. B., Lewis, J. E., Moore, T. R., Steer, P. & Wright, R. K. 1984. Schefferville permafrost research, volume I: parts 1a and 1b, summary, review and recommendations, and catalogue of available materials. Earth Physics Branch, Open File, 84-7. doi:10.4095/293687.
- Hachem, S., Allard, M., and Duguay, C.R. 2008. A new permafrost map of Quebec-Labrador derived from near-surface temperature data of the Moderate Resolution Imaging Spectroradiometer (MODIS). *In* Proceedings of the 9th International Conference on Permafrost. Fairbanks, United States of America. pp. 591–596.
- Hachem, S., Allard, M., and Duguay, C. 2009. Using the MODIS land surface temperature product for mapping permafrost: an application to northern Québec and Labrador, Canada. *Permafrost and Periglacial Processes*, **20**(4): 407–416. doi:10.1002/ppp.672.
- Hagedorn, H. 2022. Preliminary delineation of marine in sediments in east-central Labrador: Parts of NTS map areas 13F, G, I, J, K, N, and O. Current Research Newfoundland and Labrador Department of Industry, Energy and Technology.
- Hendershot, W.H. 1984. A comparison of some upland and valley soils in the Ungava-Labrador Peninsula. *Géographie physique et Quaternaire*, **38**(3): 243. doi:10.7202/032566ar.
- Herring, T., Lewkowicz, A.G., Chiasson, A., Wang, Y., Way, R.G., Young, J.M., Froese, D., Smith, S.L., Andersen, B., Bellehumeur-Génier, O., Bevington, A.R., Bonnaventure, P.P., Duguay, M.A., Etzelmüller, B., Gooseff, M.N., Godsey, S.E., and Miceli, C.M. 2024a. The Canadian Permafrost Electrical Resistivity Survey (CPERS) database: 15 years of permafrost resistivity data. *Arctic Science*. doi:10.1139/as-2023-0058.
- Herring, T., Lewkowicz, A.G., Way, R.G., Wang, Y., Chiasson, A., and Froese, D.G. 2024b. Large-scale assessment of permafrost conditions using the Canadian Permafrost Electrical Resistivity Survey (CPERS) database.
- Hustich, I. 1939. Notes on the coniferous forest and tree limit on the east coast of Newfoundland-Labrador. *Acta Geographica*, **7**(1): 5–77.
- Ives, J.D. 1960. Permafrost in central Labrador-Ungava. *Journal of Glaciology*, **3**(28): 789–790.
- Ives, J.D. 1979. A proposed history of permafrost development in Labrador-Ungava. *Géographie physique et Quaternaire*, **33**(3–4): 233–244. doi:10.7202/1000360ar.
- Jordan, R.H. 1980. Preliminary results from archaeological investigations on Avayalik Island, extreme northern Labrador. *ARCTIC*, **33**(3): 607–627. doi:10.14430/arctic2586.
- Labrie, R., Bhiry, N., Todisco, D., Finco, C., and Couillet, A. 2024. Conceptual Model of Permafrost Degradation in an Inuit Archaeological Context (Dog Island, Labrador): A Geophysical Approach. *Geosciences*, **14**(4): 95. doi:10.3390/geosciences14040095.
- Lewkowicz, A. 2014. Overview report for New Millennium Iron on permafrost conditions in the Schefferville area. Unpublished.
- Lewkowicz, A., and Way, R. 2014. Overview Report for Nunatsiavut Government on permafrost conditions in the Nain area. Unpublished.
- Moore, T.R. 1987. Thermal regime of peatlands in subarctic eastern Canada. *Canadian Journal of Earth Sciences*, **24**(7): 1352–1359. doi:10.1139/e87-129.
- Nicholson, F.H. 1979. Permafrost spatial and temporal variations near Schefferville, Nouveau-Québec. *Géographie physique et Quaternaire*, **33**(3–4): 265–277. doi:10.7202/1000363ar.
- Nicholson, F.H., and Granberg, H.B. 1973. Permafrost and snowcover relationships near Schefferville. *In* Permafrost: North American Contribution to the Second International Conference. pp. 151–158.
- Nicholson, F.H., and Thom, B. G. 1973. Studies at the Timmins 4 permafrost experimental site. *In* Permafrost: North American Contribution to the Second International Conference. pp. 159–166.
- Normandeau, A., Eamer, J.B.R., Way, R.G., Harrison, E.J., Cyr, F., Algar, C.K., Eamer, J.L., Geizer, H.D., Haddock, J., Kurylyk, B.L., Van Nieuwenhove, N., Pijogge, L., Philibert, G., Robert, K., Saunders, M., Tamborski, J., and Limoges, A. 2024. Evidence for subsea permafrost in subarctic Canada linked to submarine groundwater discharge. *Nature Geoscience*, **17**(10): 1022–1030. doi:10.1038/s41561-024-01497-z.
- Nunatsiavut Government. 2024. New Nain airport: Detail project description.
- Payette, S. 2001. Les processus et les formes périglaciaires. *In* *Écologie des tourbières du Québec-Labrador*. Les Presses de l'Université Laval, Québec City, Canada. pp. 199–239.
- Pryer, R.W. 1963. Mine railroads in Labrador-Ungava. *In* Proceedings of the 1st International Conference on Permafrost. National Academy of Sciences and National Research Council Publication, Washington, USA. pp. 503–508.

- Roberts, B.A., and Robertson, A.W. 1980. Palsa bogs, sand dunes, salt marshes, environmentally sensitive habitats in the coastal region southeastern Labrador. *In* Proceedings of workshop on research in the Labrador coastal and offshore region. St. John's, Newfoundland and Labrador. pp. 245–263.
- Roberts, B.A., Simon, N.P.P., and Deering, K.W. 2006. The forests and woodlands of Labrador, Canada: ecology, distribution and future management. *Ecological Research*, **21**(6): 868–880. doi:10.1007/s11284-006-0051-7.
- Savoie, L., and Gangloff, P. 1980. Analyse pollinique d'une palse au site archéologique de Vieux-Port-Burwell (Killiniq), Territoires du Nord-Ouest. *Géographie physique et Quaternaire*, **34**(3): 301–320.
- Seguin, M.K. 1974. The use of geophysical methods in permafrost investigation: Iron ore deposits of the central part of the Labrador Trough, Northeastern Canada. *Geoforum*, **5**(2): 55–67. doi:10.1016/0016-7185(74)90006-2.
- Seguin, M.K., and Dionne, J.-C. 1992. Modélisation géophysique et caractérisation thermique du pergélisol dans les paises de Blanc-Sablon, Québec. Geological Survey of Canada.
- Smith, J., and Melendy, W. 2015. Community Wide Hazard Assessment, Nain, NL. exp Engineering.
- Stantec. 2012. Geotechnical Investigation Torngasok Cultural Centre Nain, NL.
- Torngat Metals Ltd. 2024. Strange Lake rare earth mining project: Detailed Project Description.
- Tutton, R., Way, R., Beddoe, R., Zhang, Y., and Trant, A. 2021. Modelled soil temperature sensitivity to variable snow and vegetation conditions in low-relief coastal mountains, Nunatsiavut and NunatuKavut, Labrador.
- Voisey's Bay Nickel Company Ltd. 1997. Environmental Impact Statement for Voisey's Bay nickel-copper-cobalt mine. Impact Assessment Agency of Canada.
- Wang, Y., Lewkowicz, A., Holloway, J., and Way, R. 2021. Thermal modelling of post-fire permafrost change under a warming coastal subarctic climate, eastern Canada.
- Wang, Y., Way, R.G., and Beer, J. 2024. Multi-decadal degradation and fragmentation of palsas and peat plateaus in coastal Labrador, northeastern Canada. *Environmental Research Letters*, **19**(1). doi:10.1088/1748-9326/ad0138.
- Wang, Y., Way, R.G., Beer, J., Forget, A., Tutton, R., and Purcell, M.C. 2023. Significant underestimation of peatland permafrost along the Labrador Sea coastline in northern Canada. *The Cryosphere*, **17**(1): 63–78. doi:10.5194/tc-17-63-2023.
- Wang, Y., Way, R.G., Lewkowicz, A.G., Tutton, R., Beer, J., Colyn, V., and Forget, A. 2024. Assessing recent thaw and subsidence of peatland permafrost in coastal Labrador, northeastern Canada. *Canadian Permafrost Association, Whitehorse, Yukon, Canada*. pp. 469–476.
- Way, R., Wang, Y., Bevington, A., Bonnaventure, P., Burton, J., Davis, E., Garibaldi, M., Lapalme, C., Tutton, R., and Wehbe, M. 2021a. Consensus-Based Rock Glacier Inventorying in the Torngat Mountains, Northern Labrador.
- Way, R.G., and Lewkowicz, A.G. 2015. Investigations of discontinuous permafrost in coastal Labrador with DC electrical resistivity tomography. *In* Proceedings of GéoQuebec: 68th Canadian Geotechnical Conference and 7th Canadian Permafrost Conference. Québec City, Canada. p. 8.
- Way, R.G., and Lewkowicz, A.G. 2016. Modelling the spatial distribution of permafrost in Labrador–Ungava using the temperature at the top of permafrost. *Canadian Journal of Earth Sciences*, **53**(10): 1010–1028. doi:10.1139/cjes-2016-0034.
- Way, R.G., and Lewkowicz, A.G. 2018. Environmental controls on ground temperature and permafrost in Labrador, northeast Canada. *Permafrost and Periglacial Processes*, **29**(2): 73–85. doi:10.1002/ppp.1972.
- Way, R.G., Lewkowicz, A.G., Wang, Y., and McCarney, P. 2021b. Permafrost investigation below the marine limit at Nain, Nunatsiavut, Canada. *In* Proceedings of the 2021 Regional Conference on Permafrost: 19th International Conference on Cold Regions Engineering. pp. 38–48.
- Way, R.G., Lewkowicz, A.G., and Zhang, Y. 2018. Characteristics and fate of isolated permafrost patches in coastal Labrador, Canada. *The Cryosphere*, **12**(8): 2667–2688. Copernicus GmbH. doi:10.5194/tc-12-2667-2018.
- Wenner, C.G. 1947. Pollen diagrams from Labrador. *Geographiska Annaler*, **29**(3–4): 137–373.
- Zhang, Y., Hong, G., and Bonney, M.T. 2024. Impacts of lateral conductive heat flow on ground temperature and implications for permafrost modeling. *Scientific Reports*, **14**(1): 31595. doi:10.1038/s41598-024-78901-6.

INACCESSIBLE AND/OR UNREVIEWED LITERATURE

- Andrews, J.T. 1963. The analysis of frost heave data collected by B.J. Haywood from Schefferville, Labrador-Ungava. *Canadian Geography*, **7**: 163–174.
- Annersten, L. 1962a. Permafrost investigations. McGill Subarctic Research Paper, **12**: 102–111.
- Annersten, L. 1963a. Ground temperature measurements in the Schefferville area, P.Q. *In* Proceedings of the First Canadian Conference on Permafrost. pp. 215–217.
- Annersten, L. 1963b. Permafrost investigations in the Ferriman area, Schefferville, P.Q. McGill Subarctic Research Paper, **15**: 86–91.
- Annersten, L. 1964a. Background for the Knob Lake permafrost studies. *In* Bird, J.B. (Editor). McGill Subarctic Research Paper, **16**: 1–32.
- Annersten, L. 1964b. Investigations of permafrost in the vicinity of Knob Lake, 1961–1962. McGill Subarctic Research Paper, **16**: 51–143.
- Annersten, L. 1966. Interaction between surface cover and permafrost. *Biuletyn Peryglacjalny*, **15**: 27–33.

- Barnett, D.M. 1963. Snow depth and distribution in relation to frozen ground in the Ferriman and Denault Lake areas, Schefferville. McGill Subarctic Research Paper, **15**: 72–85.
- Barr, W. 1964. Studies in frost heave and frost penetration at Schefferville, 1963–1964. McGill Subarctic Research Paper, **19**: 79–85.
- Bird, J.B. (Editor) 1964. Permafrost studies in central Labrador-Ungava. McGill Subarctic Research Paper, **16**.
- Bonnlander, B. 1957. Permafrost research. McGill Subarctic Research Laboratory Annual Report 1956–1957.
- Bonnlander, B. 1958. Permafrost research. McGill Subarctic Research Paper, **4**: 56–58.
- Bonnlander, B., and Major-Marothy, G.M. 1964. Permafrost and ground temperature observations, 1957. McGill Subarctic Research Paper, **16**: 33–50.
- Gardner, J. 1964. A preliminary report on periglacial studies in central Quebec–Labrador. McGill Subarctic Research Paper, **19**: 86–109.
- Garg, O. 1973. In situ physico-mechanical properties of permafrost using geophysical techniques. *In* Permafrost: The North American Contribution to the Second International Conference. Washington, D.C. pp. 508–517.
- Garg, O. 1975. Slope stability studies in the Schefferville area. Proceedings 10th Symposium on Rock Mechanics, Kingston, Canada.
- Garg, O. 1976. Application of geotechnical studies in open-pit mine planning. A paper presented at the 11th Canadian Rock Mechanics Symposium. Vancouver, Canada.
- Garg, O. 1977. Permafrost section for the Groundwater Chapter. *In* CANMET Pit Slope Manual, EMR Ottawa.
- Garg, O. 1978. Practical applications of recently improved pit slope design procedures at Schefferville. Bulletin of the Canadian Institute of Mining and Metallurgy.
- Garg, O. 1978. Interpretation of seismic and resistivity surveys in permafrost in Northern Quebec. *In* 5th Symposium on Permafrost Geophysics, Calgary, Alberta, Canada.
- Garg, O. 1979. Summary of twenty-five years experience in mine dewatering at the Iron Ore Company of Canada. *In* Proceedings of the First International Mine Drainage Symposium. Denver, Colorado.
- Garg, O. 1981. Research requirements in surface mine stability and planning. *In* Proceedings of the Third International Conference on Stability in Surface Mining. Vancouver, Canada.
- Garg, O. 1981. Successful implementation of steeper slope angles in open-pit mines in Labrador, Canada. *In* Proceedings of the Third International Conference on Stability in Surface Mining. Vancouver, Canada.
- Garg, O. 1982. Recently developed blasting techniques in frozen iron ore at Schefferville, Quebec. *In* Proceedings of the Fourth Canadian Permafrost Conference. Calgary, Alberta, Canada.
- Garg, O., and Stacey, P.F. 1973. Techniques used in the delineation of permafrost in the Schefferville, P.Q. area. *In* Proceedings Seminar on Thermal Regime and Measurements in Permafrost, NRC Technical Memo 108. pp. 76–83.
- Granberg, C. 1978. Annotated bibliography of recent research undertaken in the Labrador–Ungava area, near Schefferville Quebec. McGill Subarctic Research Paper, **28**: 63.
- Gray, J.T. 1966. Permafrost studies at Knob Lake, central Labrador–Ungava, 1964–1965. McGill Subarctic Research Paper, **21**: 129–134.
- Hunter, J.A. 1974. Seismic up-hole wavefront experiments in permafrost, Schefferville, Quebec. Geological Survey of Canada Paper 74-1, Part B, 83–86.
- Ives, J.D. 1960. Permafrost investigations in central Labrador–Ungava. McGill Subarctic Research Paper 9: 32–44.
- Ives, J.D. 1961. A pilot project for permafrost investigations in central Labrador–Ungava. Department of Mines and Technical Surveys, Geographical Branch Paper 28.
- Ives, J.D. 1962. Iron mining in permafrost, central Labrador–Ungava: a geographical review. Geographical Bulletin, **17**: 66–77.
- Lang, L.C. 1966. Blasting frozen ore at Knob Lake. Canadian Mining Journal, **87**(8): 49–53.
- Nicholson, F.H. 1975. Snow depth mapping from aerial photographs for use in permafrost prediction. *In* Proceedings of the 32nd Eastern Snow Conference. pp. 124–136.
- Nicholson, F.H. 1976. Permafrost thermal amelioration tests near Schefferville, Quebec. Can. J. Earth Sci., **13**: 1694–1705.
- Nicholson, F.H. 1976. Patterned ground formation and description as suggested by low arctic and subarctic samples. Arctic and Alpine Res., **8**: 329–342.
- Nicholson, F.H. 1978. Permafrost distribution and characteristics near Schefferville, Quebec: Recent studies. *In* Proceedings Third International Permafrost Conference. pp. 427–433.
- Nicholson, F.H. 1978. Permafrost modification by changing the natural energy budget. *In* Proceedings Third International Permafrost Conference. pp. 61–67.
- Nicholson, F.H., and Lewis, J.S. 1976. Active layer and suprapermafrost groundwater studies, Schefferville, Quebec. *In* Proceedings of the 2nd A.G.U. Conference on Soil Water Problems in Cold Regions. Edmonton, Alberta, Canada. pp. 15–30.
- Seguin, M.K. 1971. Applications des méthodes électriques aux problèmes de génie. L'Ingenieur, no. 262, pp. 12–20.
- Seguin, M.K. 1974. Etat des recherches sur le pergélisol dans la partie centrale de la Fosse du Labrador, Quebec subarctique. Revue de Géographie de Montréal, **28**: 343–356.

- Seguin, M.K. 1977. Determination de la géométrie et des propriétés physiques du pergélisol discontinu de la région de Schefferville. *Canadian Journal of Earth Sciences*, **14**: 431–443.
- Seguin, M.K., and Cauchon, A. 1972. Etude expérimentale des propriétés mécaniques (statiques et dynamiques) des matériaux rocheux. *L'Ingenieur*, juillet, pp. 54–62.
- Seguin, M.K., and Garg, O.P. 1973. Delineation of frozen rocks from Labrador–Ungava Peninsula using borehole geophysical logging. *In* 9th Canadian Symposium on Rock Mechanics, Montreal, pp. 53–75.
- Thom, B.G. 1969. New permafrost investigations near Schefferville, P.Q. *Revue de Géographie de Montréal*, **23**: 317–327.
- Thom, B.G. 1969. Permafrost in the Knob Lake iron mining region. *In* Proceedings of the Third Canadian Conference on Permafrost, NRC Technical Memo 96, 9–20.
- Thom, B.G., and Granberg, H.B. 1970. Patterns of snow accumulation in a forest-tundra environment, central Labrador–Ungava. *In* Proceedings of the 27th Eastern Snow Conference, pp. 76–86.
- Williams, P.J. 1962. Quantitative investigations of soil movement in frozen ground phenomena. McGill Subarctic Research Paper, **20**, 190–197.
- Wright, R.K. 1981. The water balance of a lichen tundra underlain by permafrost. McGill Subarctic Research Paper, **33**.
- Wright, R.K. 1983. Relationships between runoff generation and active layer development near Schefferville, Quebec. *In* the Fourth International Permafrost Conference. Fairbanks, Alaska.