

EXPLORATION TARGETS IDENTIFIED

BY QUATERNARY SURVEYS

IN THE SOUTHEASTERN PART OF THE CHURCHILL PROVINCE

Hugo Dubé-Loubert, Virginie Daubois, Guillaume Allard (MERN) and Martin Roy (UQAM)



Exploration targets identified by Quaternary surveys in the southeastern part of the Churchill Province

Hugo Dubé-Loubert, Virginie Daubois, Guillaume Allard (MERN) and Martin Roy (UQAM)

PRO 2015-04

Introduction

In 2012, Géologie Québec initiated a Quaternary surveying project in the Churchill geological province. In areas of thick sedimentary cover, drift prospecting is generally a common and effective approach for assessing the mineral potential of a region.

During the summers of 2012 and 2013, nearly 500 till samples and roughly one hundred esker samples were collected in NTS map sheets 24G and 24H (Figure 1). In addition, detailed mapping of surficial deposits and erosional marks from the passage of glaciers was carried out to make the best use of the analytical results. A number of exploration targets were defined and are presented in this document.

Geological setting

The study area is located in the southeast part of the Churchill Province. It is bordered to the west by the Rachel-Laporte Zone and the Labrador Trough, and to the east by the Torngat Orogen. For additional details on the bedrock geology of the region, the reader should consult geological reports RG 2013-04 and RG 2014-02.

Surficial deposits and their associated landforms across most of the study area belong to a morphological assemblage that converges toward Ungava Bay. This assemblage of landforms reflects the late position of an ice divide associated with the Labrador-Québec sector of the Laurentide Ice Sheet. It displays alternations of streamlined forms and Rogen (ribbed) moraine fields, interspersed with glaciofluvial corridors comprising eskers. Combined drift and glaciofluvial sediment sampling were used to document the mineral potential of the area at the regional and local scales. Analytical results, along with a map of surface deposits produced from the 2012 and 2013 surveys, are available from the SIGÉOM database of the *Ministère de l'Énergie et des Ressources naturelles* (<http://sigeom.mrn.gouv.qc.ca>).

Ice movements and associated glacial dynamics

Figure 2 displays the recent ice movements that affected the study area. The movements documented in NTS map sheet 24H reflect the movement of the ice divide commonly known as the Labrador Ancestor Ice Divide (Dyke and Prest, 1987). The western part of the zone shows an ENE direction of movement (purple arrows, Figure 2), opposite to the generally westward direction (green arrows, Figure 2). The distribution and crosscutting relationships of these movements are related to the migration of the ice divide over time. For the purposes of assessing mineral potential, detailed mapping of erosional marks, as in this project, proved to be very helpful. Determining the relative chronology of movements is useful to deduce the geometry of palimpsest dispersal trains, and provides a better constraint on potential sources of mineral occurrences. The ice divide appears to have migrated from west to east according to documented crosscutting relationships, and was subsequently positioned along the George River axis, thereby allowing fields of streamlined forms to develop in the southwest part of map sheet 24H.

Finally, the most recent movement that affected the study area was generally towards the north-northwest (blue arrows, Figure 2). It is mainly documented in map sheet 24G, and in the western part of 24H, cutting across the general westerly movement (green arrows, Figure 2). In the western part of map sheet 24G, this movement built streamlined forms that alternate with fields of Rogen moraines. This zone, located between the depression of Rivière à la Baleine and the topographic highs of the Labrador Trough, appears to define an ice stream corridor. This zone of high-velocity ice is also visible east of Rivière à la Baleine, in the Rivière Qurlutuq valley.

Mineral targets defined by the 2012–2013 Quaternary surveys

The targets presented in this document (Figure 3) were determined from till and esker surveys carried out as part of the Churchill Quaternary project. Different analytical methods were combined to emphasize the boundaries of these zones. The methods included geochemical analyses on the fine-grained fraction of tills and on lake-bottom sediments, the visual analysis of heavy mineral concentrates from tills and eskers, microprobe analyses on indicator minerals, geophysical surveys, as well as other basic compositional investigations. The identified areas of interest reveal favourable settings in the secondary environment, but represent the first step in the assessment of regional mineral potential; additional work will be necessary to demonstrate their true value.

The 30 targets identified are presented in Table 1, which provides, among other things, their precise geographic coordinates and a brief description. The targets are primarily for base metals (Ni-Cu-Zn), gold and the rare earth elements. There is no evidence in the region of diamondiferous kimberlite pipes or lamprophyres.

This information is available via an interactive map on the Géologie Québec website (http://sigeom.mrn.gouv.qc.ca/signet/classes/I1108_afchCarteIntr).

Glacier dynamics and transport distances

Figure 3 shows the area covered by the study, which is divided into a mosaic of zones representing distinct subglacier dynamics. This mosaic translates in different transport distances according to zone. In the context of a regional-scale survey and in the absence of a good lithological tracer, it is difficult to determine exactly how much dilution occurred. This subdivision is thus

qualitative, but nevertheless useful for discriminating high-velocity zones from slower-velocity zones typical of cold-based ice conditions with limited ice movement. The four subdivisions below were defined according to the following parameters: geomorphology, relative ice flow chronology, chemical index of alteration (CIA), dispersal based on till matrix fines and till clast petrology.

- Zone 1: High-velocity ice zone (ice stream). Significant effective transport distance (multi-kilometre).
- Zone 2: Peripheral zone around ice stream corridors. Intermediate transport distance (kilometre-scale).
- Zone 3: Zone of cold-based glacier conditions. Little evidence of glacier erosion. Transport distance nearly nil.
- Zone 4: Zone of ice disintegration. Generally thin cover of melt-out till. Not very appropriate for sampling due to the reworking of sediments by meltwater.

This mosaic highlights the relationship between identified targets and local glacier dynamics, and provides glacier transport data that could one day be used in the search for mineral occurrences.

References

- DYKE, A.S. – PREST, V.K., 1987 – Late Wisconsinan and Holocene history of the Laurentide Ice Sheet. *Géographie physique et Quaternaire*; volume 41, pages 237–263.
- LAFRANCE, I. – SIMARD, M. – BANDYAYERA, D., 2014 – *Géologie de la région du lac Saffray* (SNRC 24G et 24F). Ministère des Ressources naturelles, Québec; RG 2014-02; 49 pages.
- SIMARD, M. – LAFRANCE, I. – HAMMOUCHE, H. – LEGOUIX, C., 2013 – *Géologie de la région de Kuujuaq et de la baie d'Ungava* (SNRC 24J et 24K). Ministère des Ressources naturelles, Québec; RG 2013-04, 60 pages.

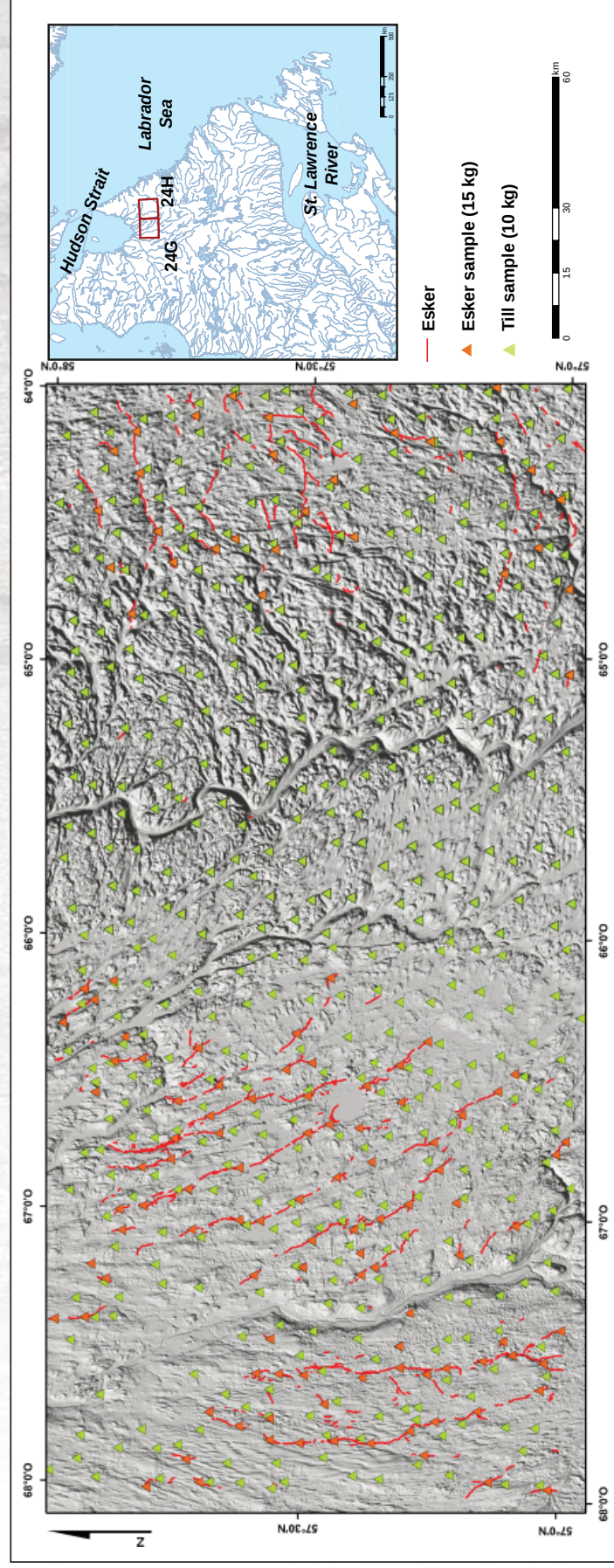


FIGURE 1 – Location of the study area and samples collected during the 2012 and 2013 field programs.

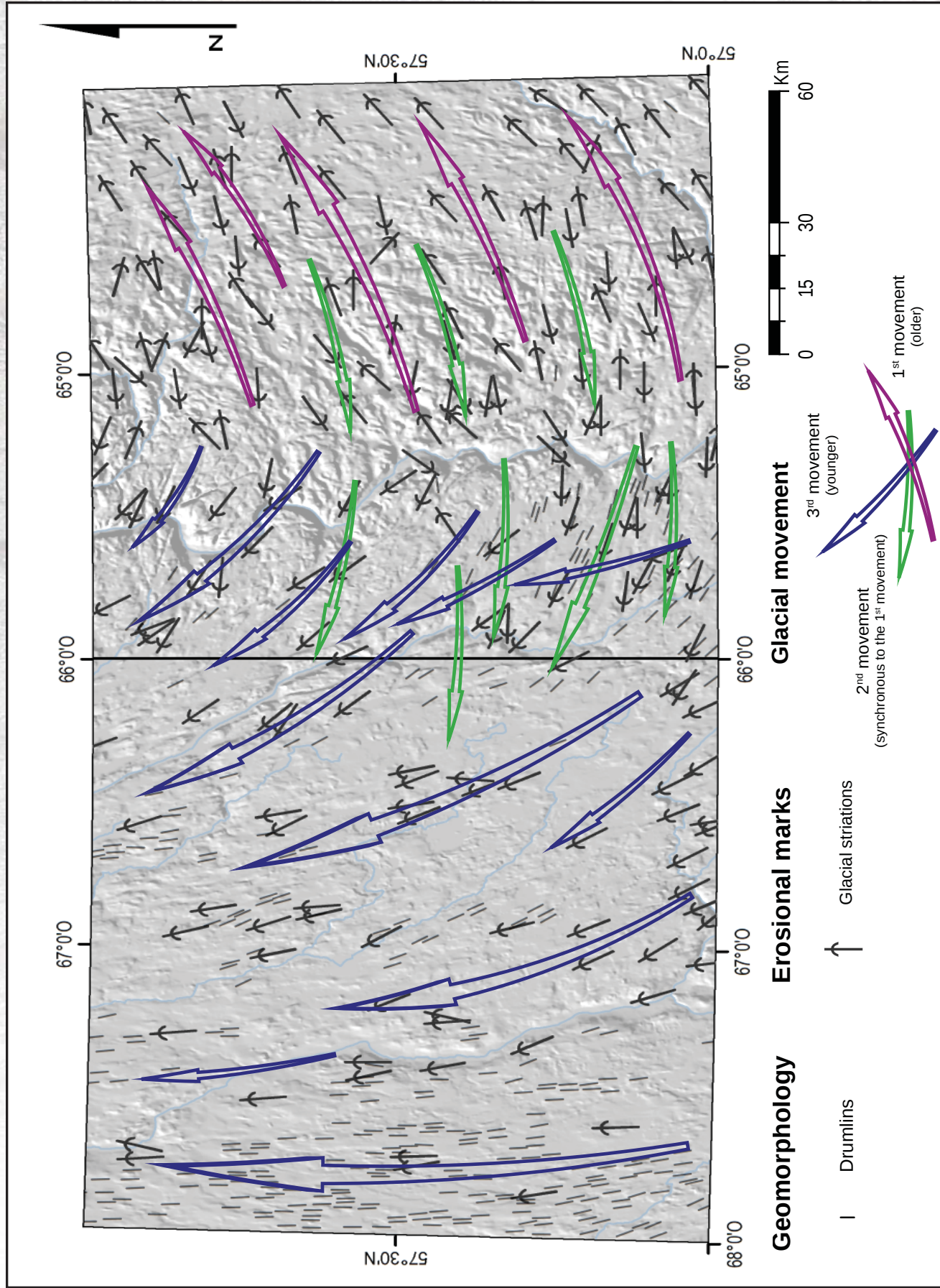


FIGURE 2 – Sequence and relative chronology of recent glacial movements in the study area. The extent of different movements is indicated by arrow lengths.

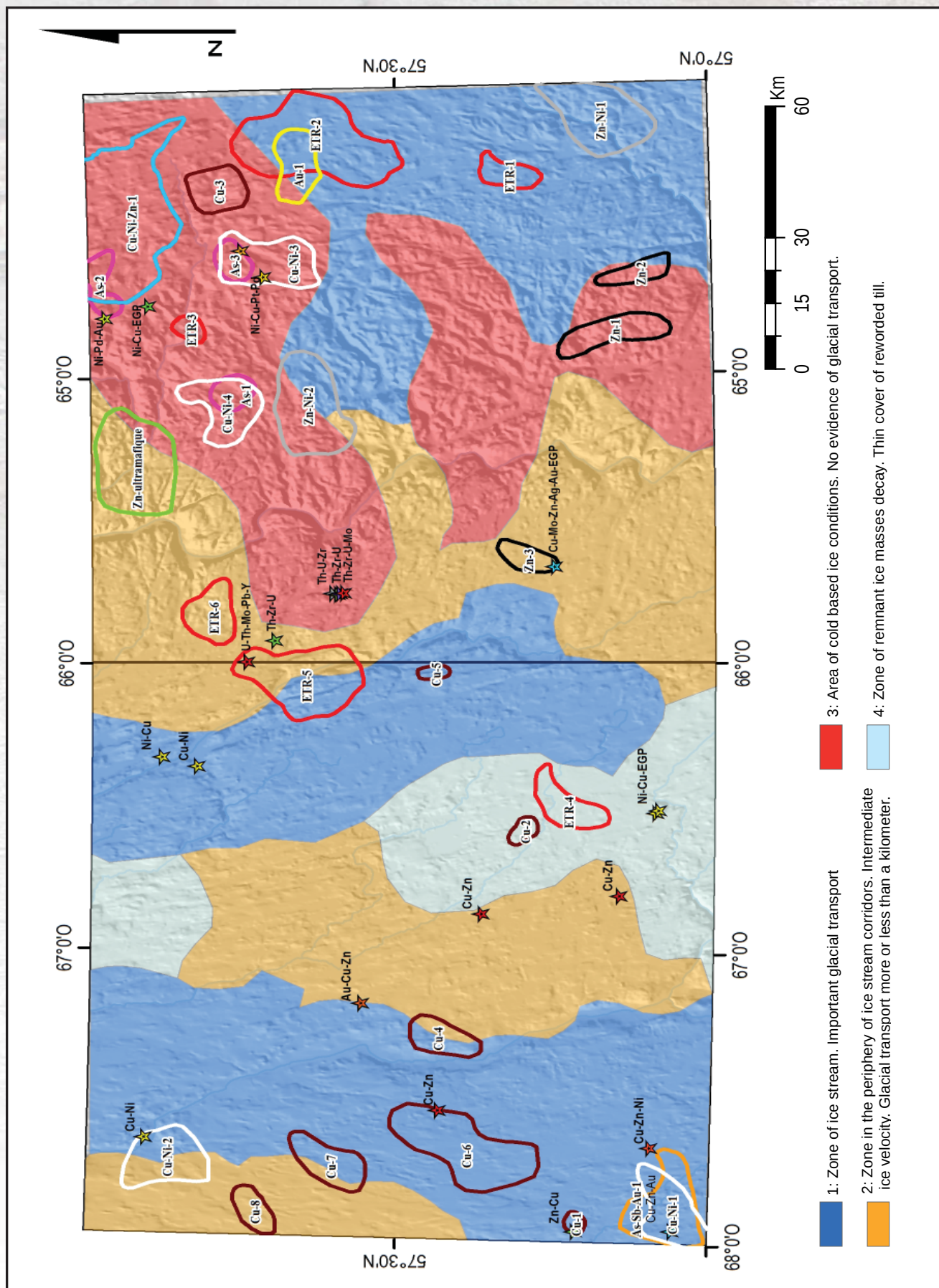


FIGURE 3 – Mosaic of subglacial conditions and their associated relative transport distances.

TABLE 1 – Summary description of the quaternary targets identified.

Name	Surface area (km ²)	NTS	Project	Person(s) in charge	Substance(s)	Description
As-1	43.63	24H14-24H11	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	As	As anomalies in till (5.4 ppm) and lake sediments (18.6 ppm). Arsenopyrite found in the down-ice till of the zone.
As-2	52.87	24H15	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	As	As (4.2 ppm) and Sb (0.3 ppm) anomalies in till. As anomaly in lake sediments (9.4 ppm).
As-3	41.69	24H15-24H10	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	As	As anomaly in till (11.8 ppm) and in lacustrine sediments (6.6 ppm). Near a nickel exploration target based on mapping work (peridotite with rusty zones).
As-Sb-Au-1	171.37	24H09	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	As-Sb-Au	As (4.7 ppm) and Sb (0.4 ppm) anomalies in till, and As (13.7 ppm) and Sb (0.3 ppm) anomalies in lake sediments. A grain of gold and loellingite was found in an esker.
Au-1	94.55	24H09	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	Au	Au anomaly (6 ppb) in till, and Sb anomaly (0.15 ppm) in lake sediments.
Cu-1	12.8	24G04	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	Cu	Cu anomaly (74 ppm) in till, and Cu (88.45 ppm) and Ni (61 ppm) anomalies in lake sediments. Chalcopyrite in till. Near an exploration target: outcrops containing 5-10% disseminated sulphides (PO-CP).
Cu-2	20.53	24G07	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	Cu	Cu anomaly in till (128 ppm), and Cu (145.4 ppm) and Ni (75 ppm) anomalies in lake sediments.
Cu-3	83.31	24H09-24H16	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	Cu	Cu anomaly (90 ppm) in till. Presence of chalcopyrite, and a concentration of ultramafic indicator minerals (forsterite) in drift.
Cu-4	72.72	24G06	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	Cu	Cu anomaly (193 ppm) in till. Cu (193 ppm), Ni (99 ppm) and Zn (283.3 ppm) anomalies in lake sediments.
Cu-5	13.39	24G08	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	Cu	Cu anomaly (106 ppm) in till. Includes a magmatic Ni-Cu target determined by spatial regression.
Cu-6	262.35	24G05-24G12	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	Cu	Chalcopyrite concentrations of up to 18 grains in eskers and 9 grains in till. Presence of arsenopyrite and loellingite in tills and eskers. Presence of spinels associated with metamorphosed massive sulphides.
Cu-7	97.06	24G12	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	Cu	Concentration of chalcopyrite grains in drift and glaciofluvial sediments, with up to 15 grains of chalcopyrite in eskers and 16 grains in till. Presence of arsenopyrite in an esker.
Cu-8	48.97	24G12-24G13	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	Cu	Concentration of chalcopyrite grains in drift and glaciofluvial sediments. Up to 16 grains of chalcopyrite in eskers, and 4 grains in till.
Cu-Ni-1	135.67	24G04	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	Cu-Ni	Cu anomaly (123 ppm) in till, and Cu (127 ppm) and Ni (113 ppm) anomalies in lake sediments. Chalcopyrite in till (20 grains) and eskers (6 grains). Includes targets for Ni (spatial regression) and sulphides (mapping target).
Cu-Ni-2	145.26	24G13	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	Cu-Ni	Up to 61 ppm Cu and 201 ppm Cr in till. Presence of chalcopyrite (up to 42 grains) and loellingite in till. Includes Cu and Cu-Ni targets determined by spatial regression using lake sediment data.
Cu-Ni-3	156.99	24H10-24H15	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	Cu-Ni	Cu (90 ppm) and Cr (138 ppm) anomalies in till. Chalcopyrite and forsterite in till and eskers. Cu and Ni anomalies in lake sediments. Includes Ni-Cu-Cr-PGE targets in an ultramafic intrusion, identified by spatial regression.
Cu-Ni-4	127.95	24H11-24H14	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	Cu-Ni	Cu anomalies (100 ppm) and presence of chalcopyrite, molybdenite and loellingite in till. Ni (148.7 ppm) and Cu (113.7 ppm) anomalies in lake sediments.

TABLE 1 (continued) – Summary description of the quaternary targets identified.

Name	Surface area (km ²)	NTS	Project	Person(s) in charge	Substance(s)	Description
Cu-Ni-Zn-1	488.99	24H15-24H16	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	Cu-Ni-Zn	Cu (80 ppm), Zn (210 ppm) and Cr (164 ppm) anomalies in till, and Cu (192.9 ppm), Ni (178.6 ppm) and Zn (246.1 ppm) anomalies in lake sediments. Presence of chalcocopyrite and molybdenite in till.
ETR-1	50.87	24H08	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	REE	REE anomalies observed in till samples (291.26 ppm TREE) and lake sediments (581.5 and 672.4 ppm TREE).
ETR-2	368.89	24H09	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	REE	REE anomalies in tills and lake sediments, with respective values up to 444.46 ppm TREE and 747.98 ppm TREE. Presence of Nb-rutile and Nb-ilmenite in three till samples.
ETR-3	22.99	24H15	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	REE	REE anomalies in lake sediments (782.37 ppm TREE) and presence of Nb-ilmenite in drift and glaciofluvial sediments.
ETR-4	85.45	24G01-24G02-24G07-24G08	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	REE	REE anomalies in till samples (up to 395 TREE) and in lake sediments (534 ppm TREE). Presence of monazite in till.
ETR-5	239.36	24G09-24G16-24H12-24H13	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	REE	REE anomaly in till and lake sediments, with respective values of 338.63 and 1096.66 ppm TREE. Presence of Nb-pyrophillite in till. Includes a target for La in FeO-Cu-U-REE-type deposits (spatial regression), and U showings.
ETR-6	88.04	24H13	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	REE	REE anomaly (297.01 ppm TREE) in drift. Presence of Nb-ilmenite and Nb-rutile in till.
Zn-1	100.21	24H02	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	Zn	Zn anomalies (230 ppm) in drift associated with a mapping exploration target comprising sulphide mineralization (PY-PO).
Zn-2	47.33	24H02	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	Zn	Zn anomaly (140 ppm) and presence of molybdenite in till. Presence of chalcocopyrite in glaciofluvial sediments. Near a mapping exploration target containing sulphide mineralization (PY-PO).
Zn-3	45.47	32C04	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	Zn	Zn anomaly (180 ppm) and presence of arsenopyrite in till. Near the Tunulic volcano-sedimentary belt.
Zn-Ni-1	219.62	32C15	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	Zn-Ni	Zn (634.4 ppm) and Ni (75.8 ppm) anomalies in lake sediments. Cr (173 ppm) anomaly, concentration of ultramafic indicator minerals (forsterite), and presence of arsenopyrite and molybdenite in till.
Zn-Ni-2	207.51	32C15	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	Zn-Ni	Zn anomaly (170 ppm) and molybdenite in till. Presence of chalcocopyrite in drift and glaciofluvial sediments. Ni targets for magmatic Ni-Cu deposits determined by spatial regression (lake sediments).
Zn-ultramafique	258.58	32C15	Churchill Quaternary	Virginie Daubois Hugo Dubé-Loubert Guillaume Allard	Zn	Concentration of ultramafic indicator minerals (forsterite), Zn anomaly (230 ppm) and presence of chalcocopyrite in till. Zn (198.1 ppm), Cu (91.1 ppm) and Ni (64.1 ppm) in lake sediments.

