QUALITATIVE INTERPRETATION OF AEROMAGNETIC DATA

IN THE RIVIÈRE BURON AND RIVIÈRE BROCHANT AREAS

WEST COAST OF UNGAVA BAY

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Introduction

In the summer of 2014, Géologie Québec conducted two new contiguous geophysical surveys in the Far North region of Québec (Intissar *et al.*, 2015; Benahmed *et al.*, 2015). These aeromagnetic and gamma-ray spectrometric surveys were carried out over the boundary between the Superior and Churchill geological provinces, west of Ungava Bay (Figure 1). They entirely or partially cover 36 NTS map sheets at a scale of 1:50,000, corresponding to a total surface area of roughly 23,400 km^2. The results of these surveys have been published in two new reports that provide an overview of each survey's technical aspects, the geophysical maps at 1:50,000 scale, and associated numerical data (documents DP 2015-01 and DP 2015-02 available at: http:// www.mern.gouv.qc.ca/produits-services/mines.jsp, via "E-Sigeom (Examine)").

This promotional document presents the results of the preliminary interpretation of the aeromagnetic data obtained from these two surveys, along with targets and new favourable areas for exploration.

It should be noted that a number of roughly circular magnetic anomalies, potentially representing vertical kimberlite pipes, were identified in the publications mentioned above.

Regional geological context and mineral potential

The two surveys cover the Archean rocks of the Minto Subprovince (Superior Province) in the west, and the Paleoproterozoic rocks of the Churchill Province in the east (Figure 2). The Churchill rocks are in structural contact with the Archean craton (Madore *et al.*, 1999). The contact between the two provinces is represented by a major ductile deformation zone likely associated with thrusting of the Churchill units over the Archean craton during the New Québec orogenesis.

The units of the Minto Subprovince, except for some Proterozoic diabase dykes, are mainly of Archean age. These units are typically metamorphosed from amphibolite facies to granulite facies. This part of the Minto Subprovince is divided into two distinct tectonic domains: the Utsalik Domain to the west and the Douglas Harbour Domain to the east. These two domains mainly comprise plutonic and gneissic units. Several small volcano-sedimentary units are also present, mainly in the Douglas Harbour Domain. The latter is subdivided into three lithodemic units: 1) the Troie Complex (in the south), 2) the Faribault-Thury Suite (in the centre) and 3) the Qimussinguat Complex (in the north). The volcano-sedimentary units are mainly found in the Faribault-Thury Suite. These volcano-sedimentary segments are small (5 to 10 km) and often highly deformed. The relationship between these sequences with adjacent rocks is ambiguous. Work by Madore *et al.* (1999) demonstrates that some of these belts were tectonically transposed with the intrusive rocks, and that their contacts are highly sheared. Some showings of gold, silver and copper have been documented in this area. These showings are mainly associated with volcano-sedimentary belts, more specifically with metavolcanic rocks and Archean sulphide-facies iron formations. Madore *et al.* (2009) suggested that the mafic-ultramafic or synvolcanic intrusions in the area could also represent favourable environments for IOCG-type mineralization. Lamothe (2010) performed a mineral potential assessment of the Far North region using levelled lake-bottom sediment geochemistry data. Based on this work, the study area has strong potential for Olympic Dam–Kiruna Fe-Cu-U-Au-Ag deposits, magmatic Ni-Cu deposits and massive sulphide Cu-Zn deposits associated with volcanic rocks. Several exploration targets for these types of mineralization have been published for the area.

The units in the southeast part of the Churchill Province are mainly of Paleoproterozoic age (2.17 to

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1.87 Ga). Clark and Wares (2004) divided this area into several lithotectonic zones. The Core Zone, in the east, corresponds to an Archean craton that was deformed and reworked during the Paleoproterozoic. This zone is composed of Archean gneiss and Paleoproterozoic supracrustal and plutonic rocks. The Core Zone is bordered to the west by deformed Paleoproterozoic units of the Labrador Trough. The boundary between the Core Zone and the Labrador Trough is represented by the Rachel-Laporte Zone, composed of metamorphosed volcano-sedimentary rocks. It also comprises several Archean complexes corresponding to thrust sheets that were thrust over Paleoproterozoic sequences during the New Québec orogenesis. The rocks of the Labrador Trough are assigned to the Kaniapiskau Supergroup. This unit comprises three main volcano-sedimentary cycles, and forms a major synclinorium that unconformably overlies the Superior craton. Metamorphism in the Labrador Trough increases from west to east. It passes gradually from subgreenschist facies in the west to upper greenschist, amphibolite or granulite facies in the east (Clark and Wares, 2004). The Labrador Trough has been the subject of numerous exploration and mapping programs due to its strong and highly diverse economic potential, which includes deposits associated with iron formations, stratiform sedimentary copper, rare metals associated with carbonatites, Kambalda-type Ni-Cu deposits, Cu-Ni in mafic to ultramafic intrusions, and lode gold deposits.

The work by Lamothe (2010) on the secondary environment underscores the strong potential of the study area for IOCG-type deposits, magmatic Ni-Cu deposits and Cu-Zn massive sulphide deposits associated with volcanic rocks.

The aeromagnetic data presented here demonstrates the complexity of the geology in the study area. For example, the magnetic signature of the Troie Complex, previously considered as a relatively homogenous unit on the geology map of RG 99-07 (Madore *et al.*, 1999), demonstrates much greater geological complexity as revealed by the presence of several magnetic units.

Mineral exploration targets and favourable zones

The combination of recent magnetic survey data and geochemical and geological data has led to the proposal of several exploration targets (Figures 3, 4 and 5). Furthermore, aeromagnetic maps were useful in delineating zones characterized by a high intensity in the residual total magnetic field, which may be caused by iron formations favourable to iron ore exploration (Figures 6, 7 and 8). Also identified were the possible extensions of belts of volcano-sedimentary rocks that have been mapped in the region (Figures 6, 7 and 8).

Exploration targets associated with magnetic anomalies

A qualitative examination of the residual total magnetic field map (Figure 3) and the products derived from it — the analytic signal (Figure 4) and the first vertical derivative (Figure 5) — led to the identification of several positive or negative magnetic anomalies of various sizes. Some of these anomalies correspond to or are located near the exploration targets identified by lake-bottom sediment analysis (Lamothe, 2010). These magnetic anomalies represent the units that host the mineralization responsible for the geochemical anomalies. In all, 12 magnetic anomalies could be associated with geochemical anomalies (Figures 3, 4 and 5). Table 1 provides the location and brief description of these magnetic anomalies.

Favourable zones for iron exploration

The part of the Labrador Trough covered by the aeromagnetic surveys displays strong positive magnetic anomalies associated with iron formations. The iron formations of the Sokoman Formation, located in the eastern part of the study area, are easily visible on the residual total magnetic field map (Figure 6) thanks to their very distinct magnetic signature compared to the surrounding rocks. These formations are, for the most part, already known (for example, the Hopes Advance deposit), and are the subject of exploration permits. Nevertheless, the examination of residual total magnetic field maps, the analytic signal and the first vertical derivative (Figures 6, 7 and 8) indicate the presence of other anomalies of strong amplitudes with signatures fairly similar to those of known iron formations, thus representing favourable zones for iron exploration.

Possible extensions of greenstone belts

The 1:250,000 geology map of the area covered by these surveys indicates the presence of several greenstone belts. This map was generated based on field observations and low-resolution magnetic map published by the Geological Survey of Canada. The new high-resolution surveys made it possible in some cases to redefine the boundaries of already mapped greenstone belts, and in other cases to propose possible extensions (Figures 6, 7 and 8).

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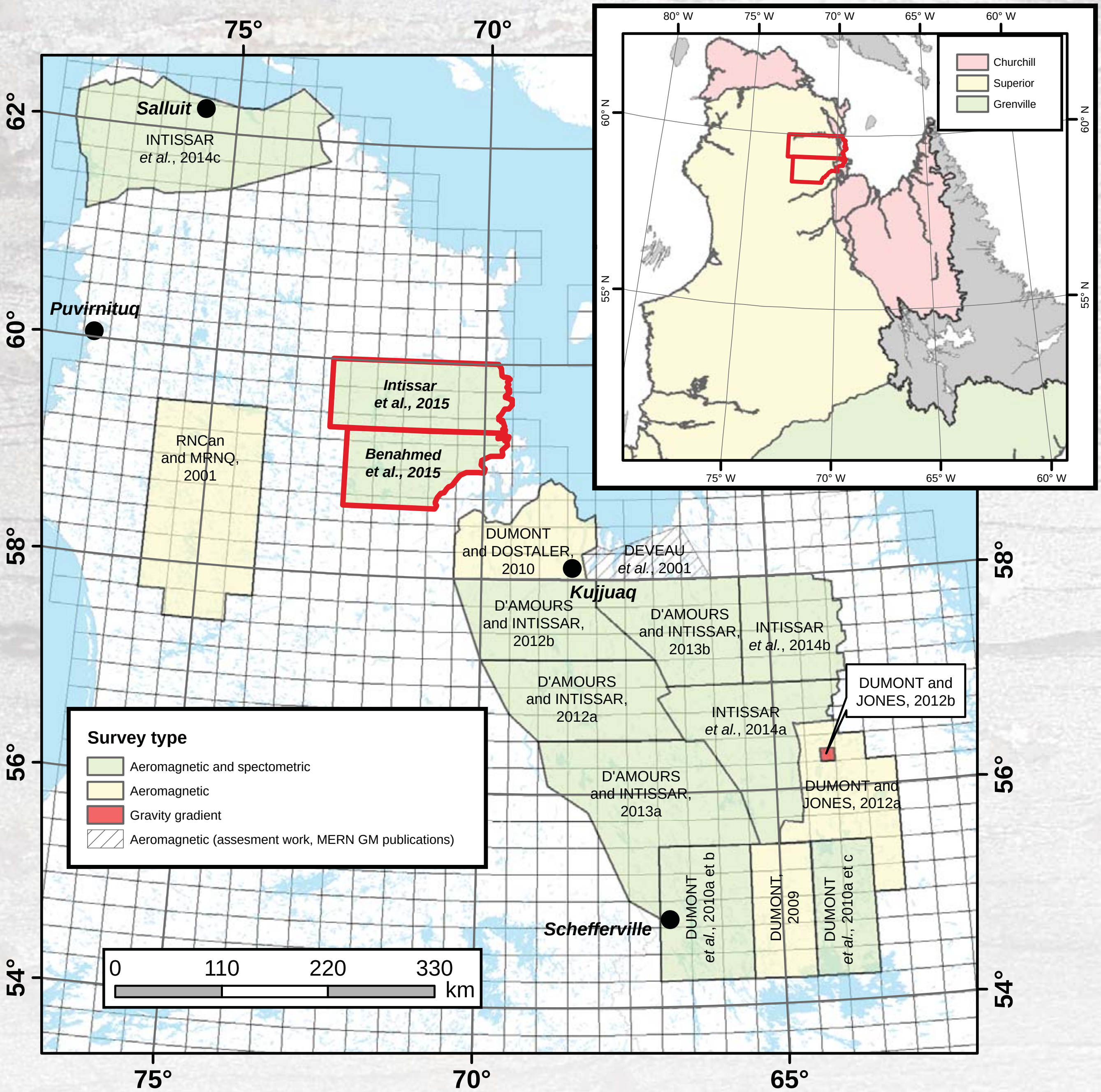

FIGURE 1 – Location of current and recent geophysical surveys in Northern Québec.

TABLE 1 – Description of aeromagnetic targets and associated geochemical targets.

Targets	Surface area (km²)	UTM Z19, NAD83 coordinates		Associated geochemical target	Description of the magnetic anomaly
		Easting	Northing		
1	1.95	329054	6557667	U anomaly for FeOx-Cu-U-REE-type deposits	Narrow, high-intensity N-S anomaly
2	0.52	328030	6576219	Ni anomaly	Isolated positive anomaly
3	0.5	328827	6642488	Magmatic Ni-Cu anomaly	Strong positive NW-SE anomaly
4	0.97	434877	6645846	U anomaly for FeOx-Cu-U-REE-type deposits	Isolated high-intensity positive anomaly
5	8.7	286009	6591281	Ni anomaly	Positive NNW-SSE anomaly
6	4.6	328934	6566270	U anomaly for FeOx-Cu-U-REE-type deposits	Large anomalous zone
7	1.55	335009	6563376	U anomaly for FeOx-Cu-U-REE-type deposits	Narrow positive N-S anomaly
8	9.01	379801	6645077	Cu anomaly for VMS-type deposits	Large, high-intensity positive E-W anomaly
9	2.44	380951	6620782	Cu anomaly for FeOx-Cu-U-REE-type deposits	Narrow high-intensity NE-SW anomaly
10	39.75	299846	6517230	Zn anomaly	Negative magnetic anomaly suggesting an intrusion
11	7.75	306134	6512521	Zn anomaly for VMS-type deposits	Anomaly with a similar signature to a dyke identified using analytic signal
12	21.5	329837	6601866	Ni anomaly	Very large, high-intensity positive anomaly

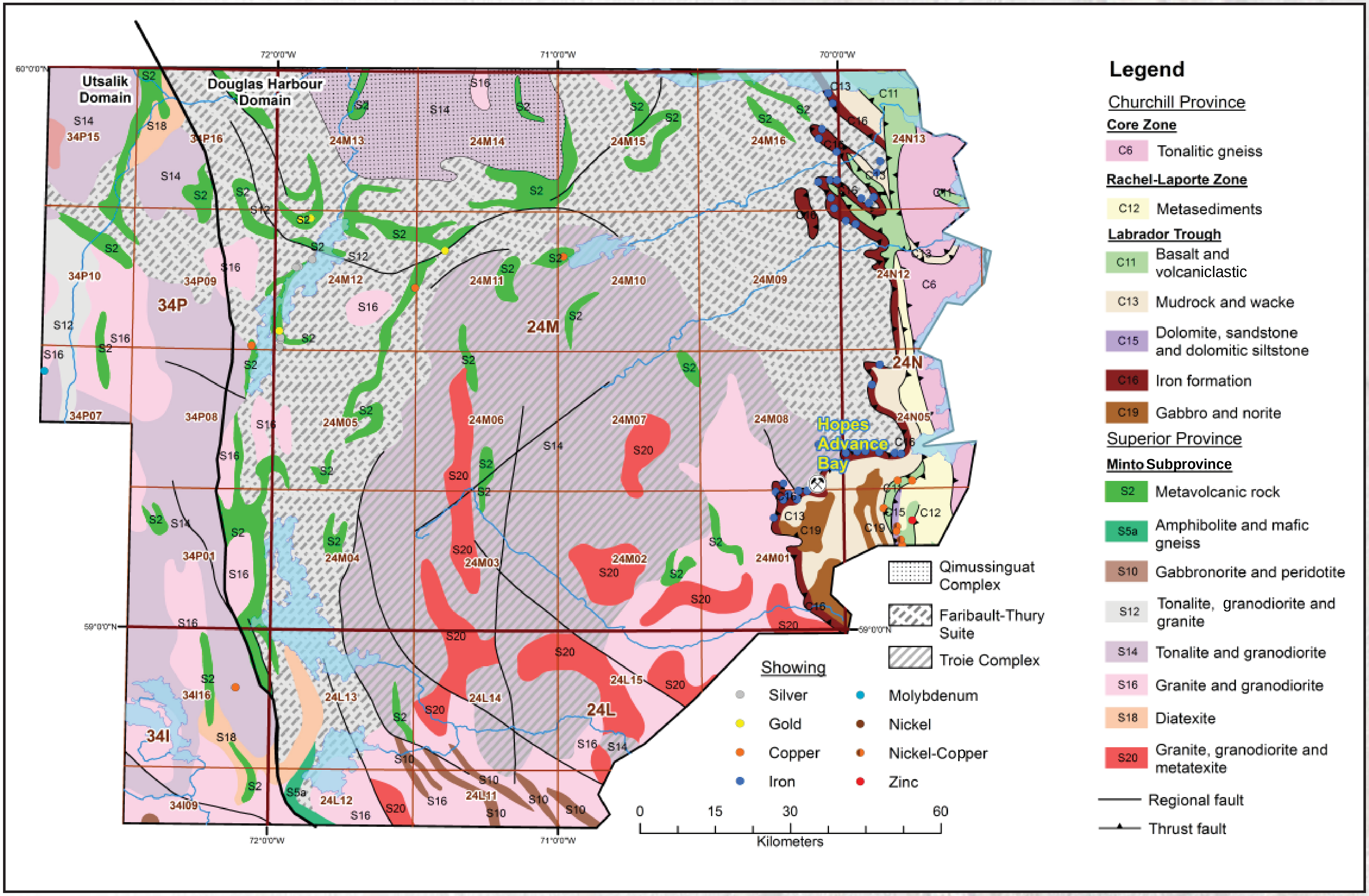

FIGURE 2 – Simplified geology map of the study area showing the location of mineralization.

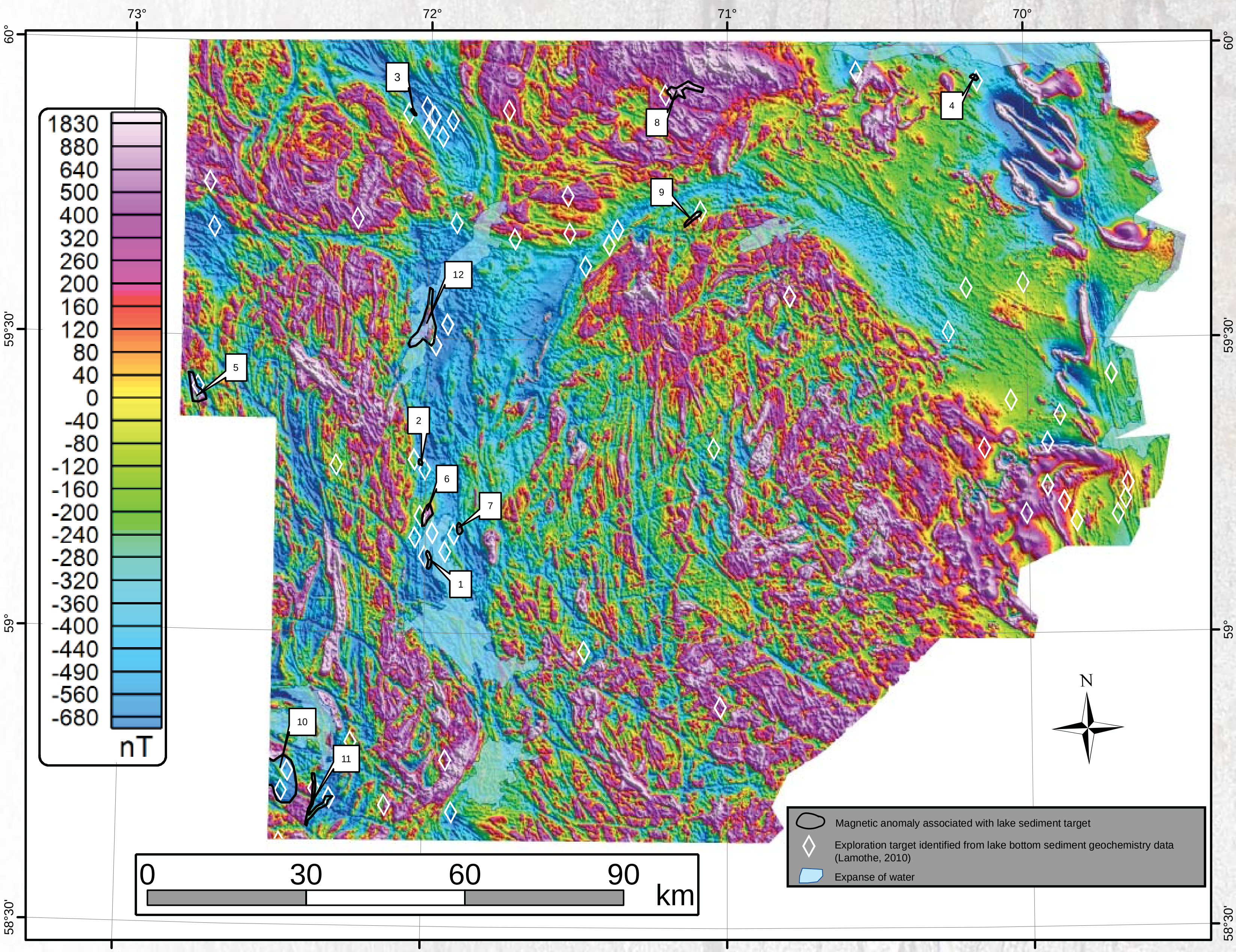

FIGURE 3 – Exploration targets defined by aeromagnetic anomalies associated with lake-bottom geochemistry targets, superimposed on a residual total magnetic field map.

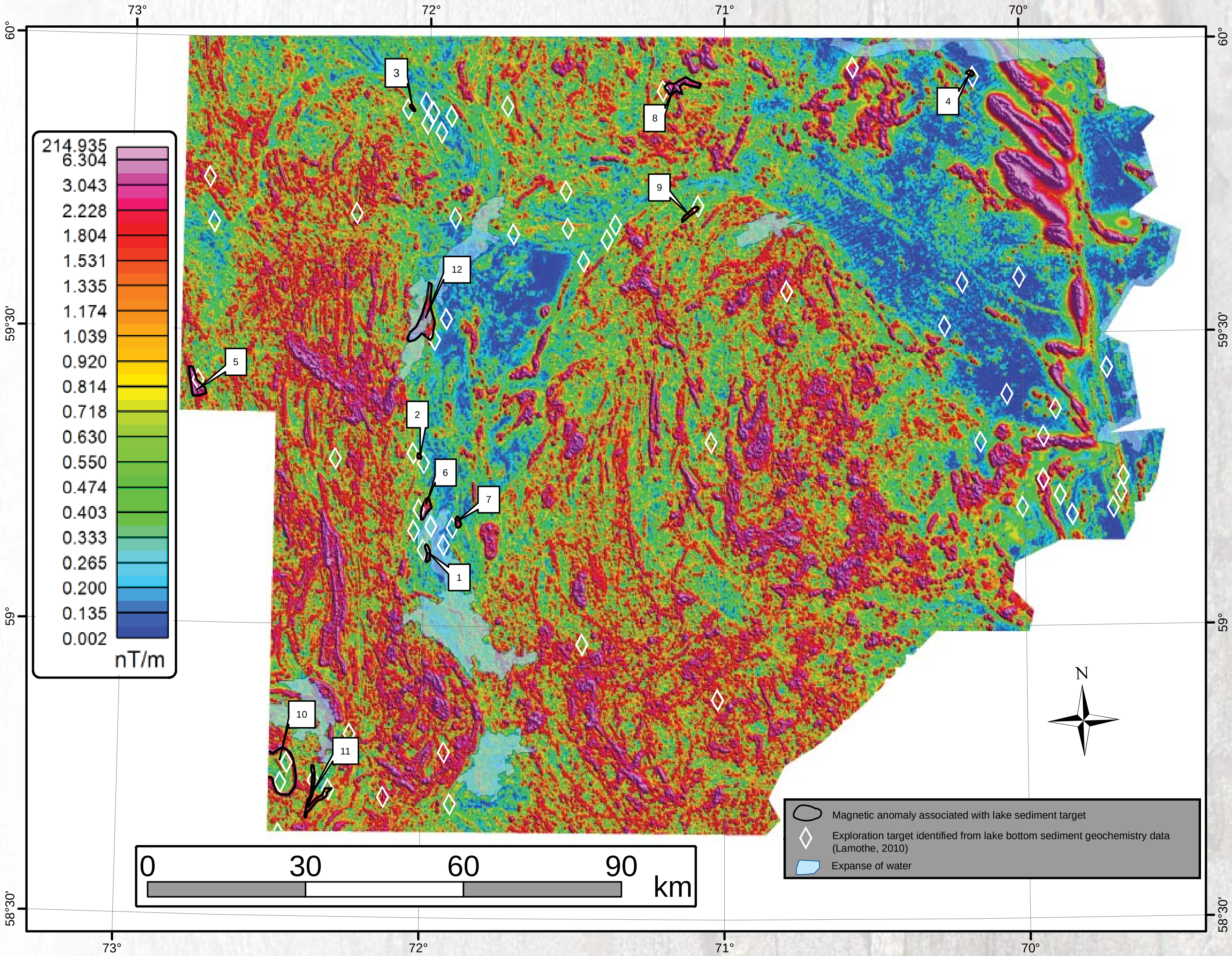

FIGURE 4 – Exploration targets defined by aeromagnetic anomalies associated with lake-bottom geochemistry targets, superimposed on a map of the analytic signal of the residual total magnetic field.

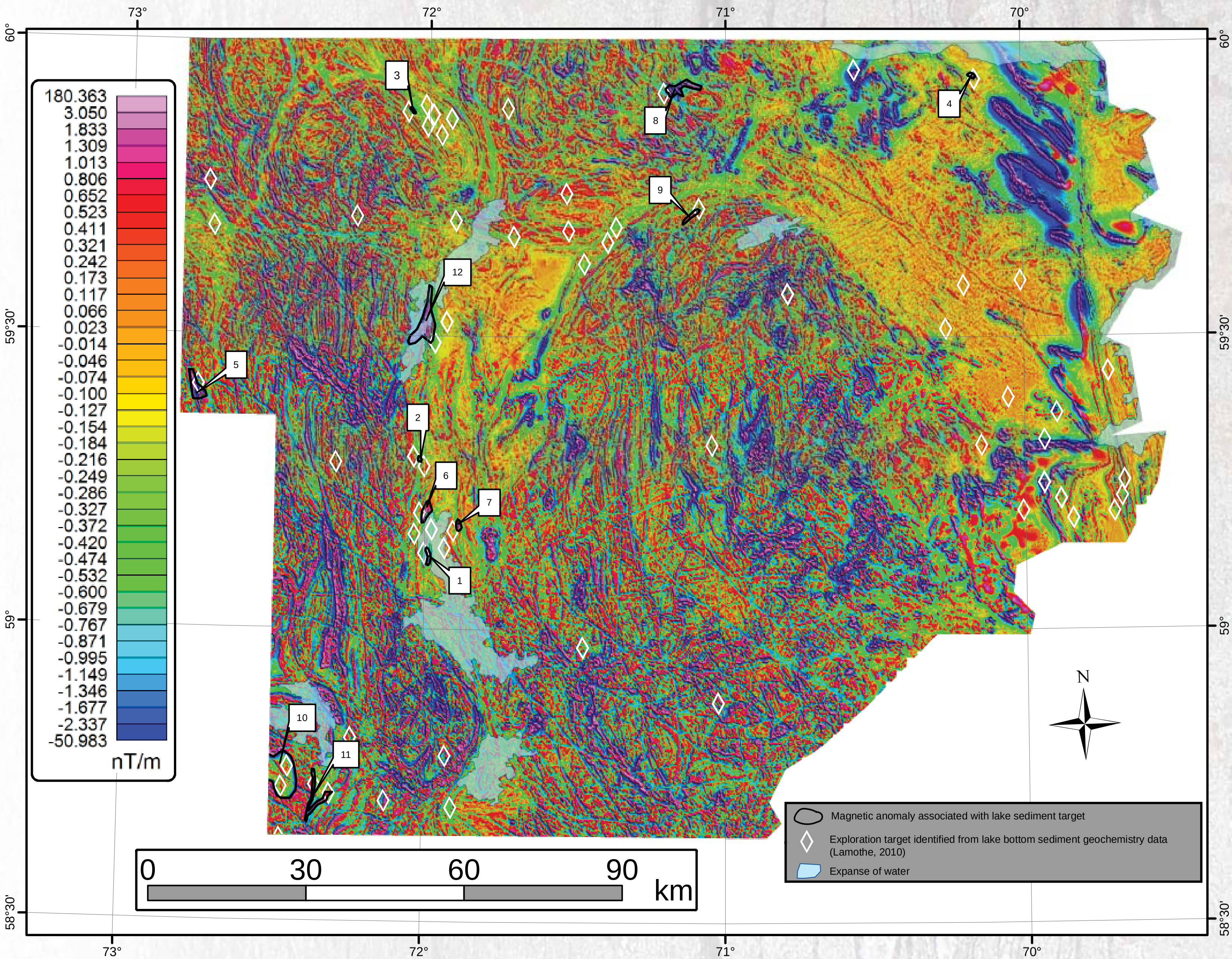

FIGURE 5 – Exploration targets defined by aeromagnetic anomalies associated with lake-bottom geochemistry targets, superimposed on a map of the first vertical derivative of the residual total magnetic field.

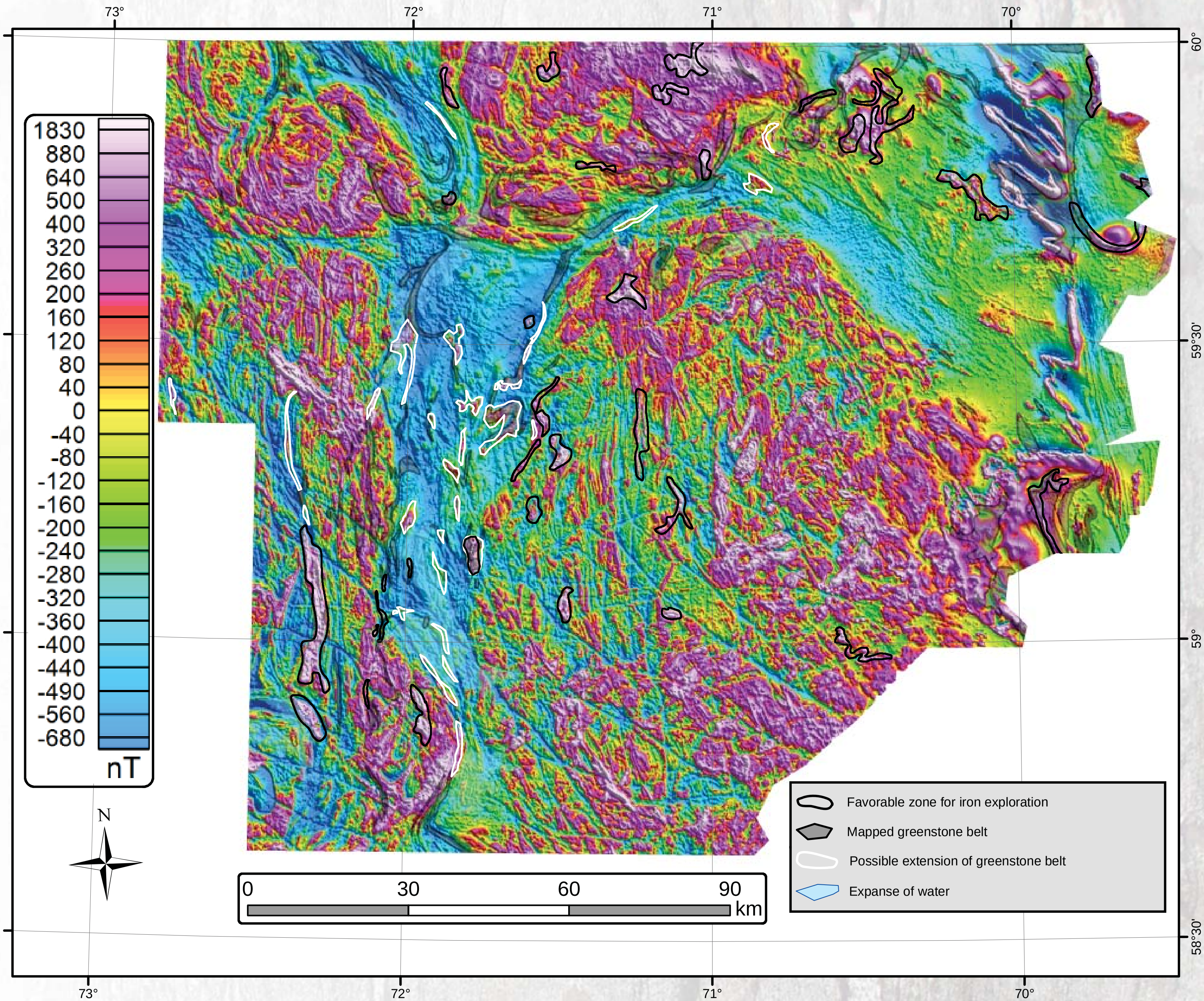

FIGURE 6 – Zones considered favourable for iron formation exploration and for potential greenstone belt extensions qualitatively assessed using the signatures of aeromagnetic anomalies and superimposed on a map of the residual total magnetic field.

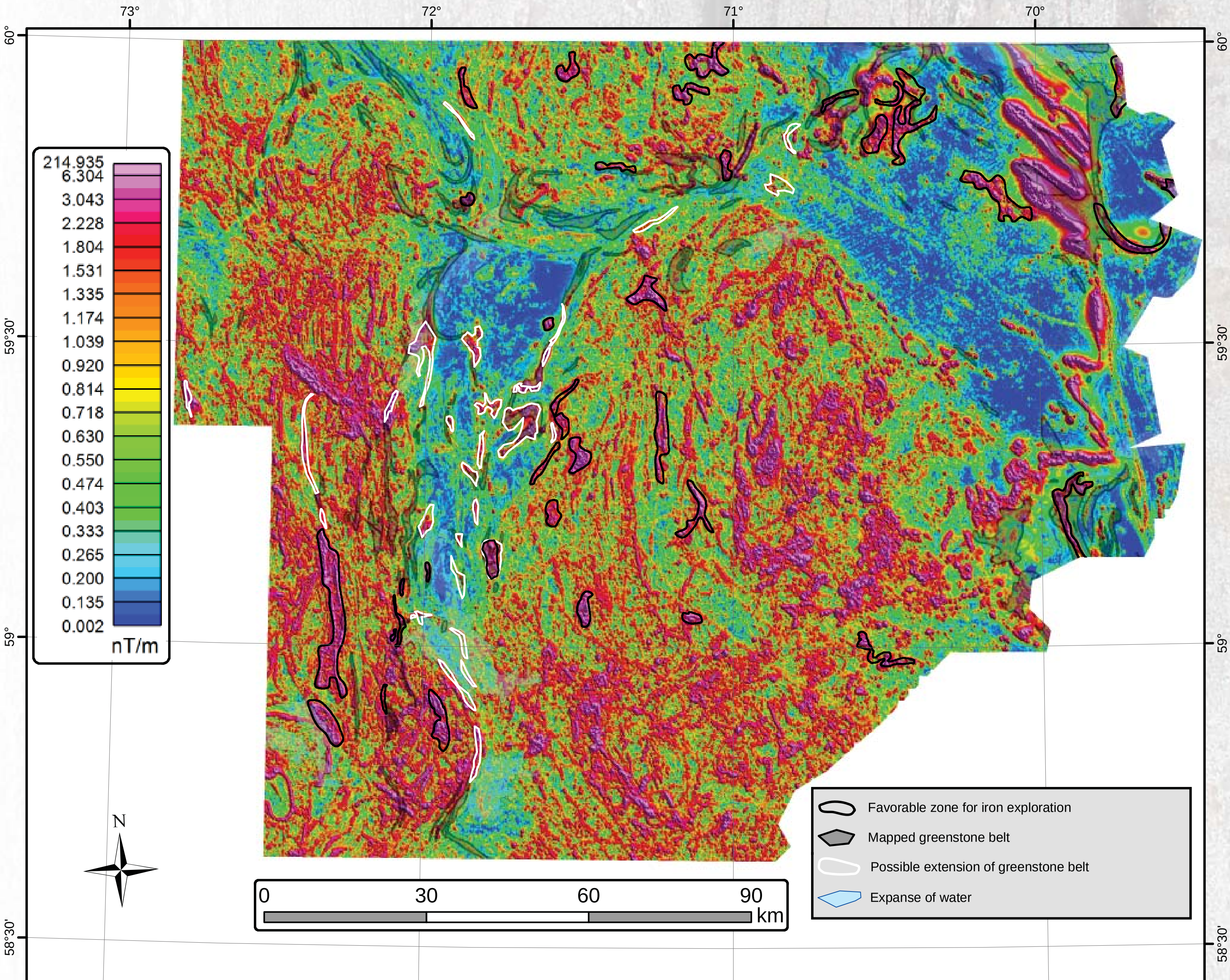

FIGURE 7 – Zones considered favourable for iron formation exploration and for potential greenstone belt extensions qualitatively assessed using the signatures of aeromagnetic anomalies and superimposed on a map of the analytic signal of the residual total magnetic field.

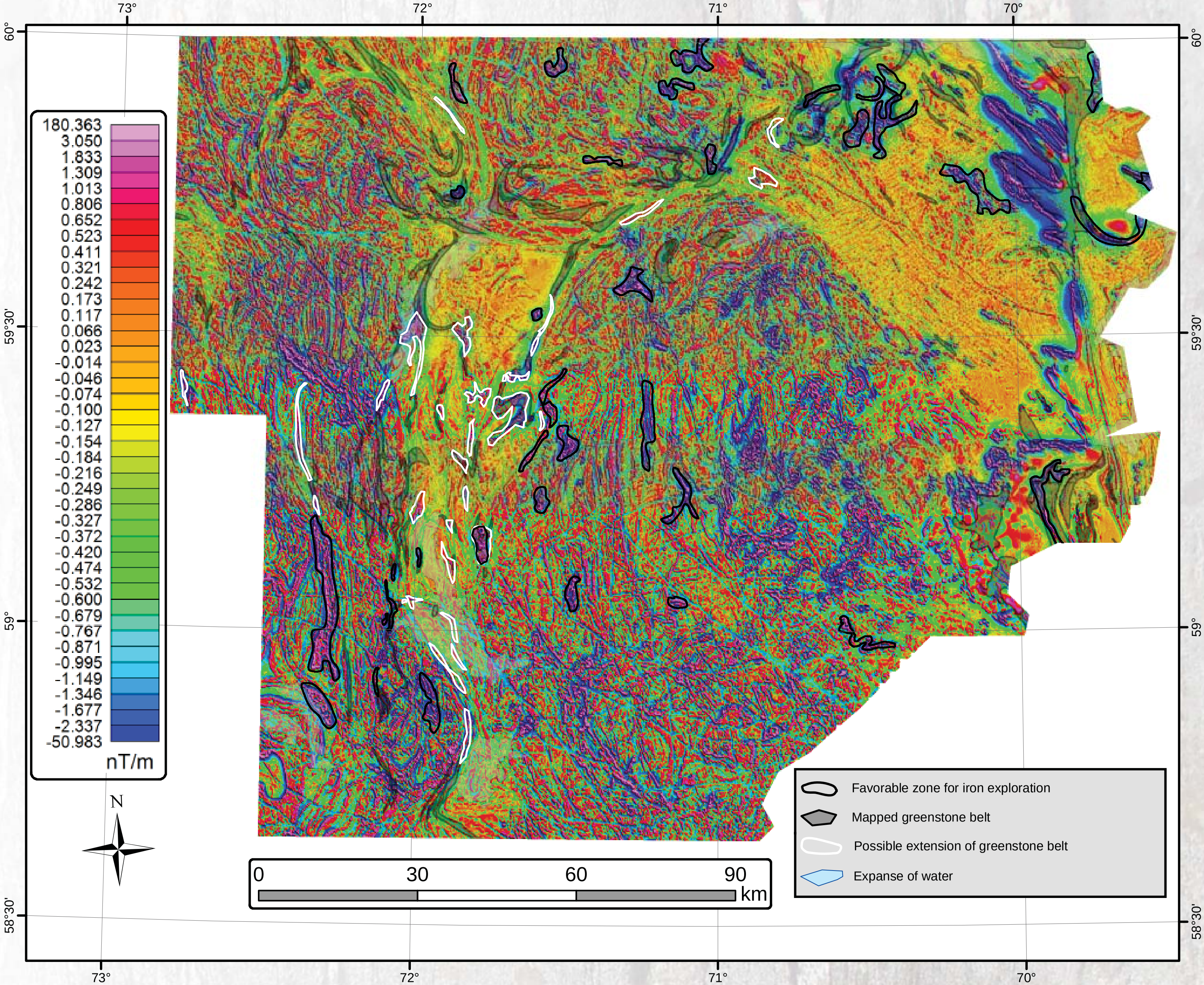

FIGURE 8 – Zones considered favourable for iron formation exploration and for potential greenstone belt extensions qualitatively assessed using the signatures of aeromagnetic anomalies and superimposed on a map of the first vertical derivative of the residual total magnetic field.