

# NEW GEOCHEMICAL LAKE SEDIMENT SURVEY IN QUÉBEC'S EXTREME NORTH

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## Introduction

The *Ministère des Ressources naturelles et de la Faune du Québec* announces the publication of new lake sediment geochemical data north of latitude 61° (Figure 1). The samples were collected in the summer of 2011 and cover the northern part of the Superior Province and Ungava Orogen (Figure 1). These data represent a new exploration tool for this region and are available in SIGÉOM at the following address under the tab "Geochemistry – Sediment sample":

[http://sigeom.mrnf.gouv.qc.ca/signet/classes/I1102\\_indexAccueil?l=a](http://sigeom.mrnf.gouv.qc.ca/signet/classes/I1102_indexAccueil?l=a).

This document contains several maps presenting the newly acquired data that may be of interest to the mineral exploration community. The data was used to define fourteen areas of interest not covered by mining titles as at January 30, 2012; these are presented on Figures 2, 3 and 4.

## Methodology

The lake sediment survey was carried out from July 12 to August 22, 2011 by the firm Geo Data Solutions GDS Inc. A total of 2,957 samples were collected with a density of about one sample per 13 km<sup>2</sup>, over an area of more than 39,000 km<sup>2</sup>. The northeast part of the survey covers an area of about 1,500 km<sup>2</sup> where there are very few lakes, which was therefore not sampled (Figures 2, 3 and 4). Also, no samples were taken within protected areas since these have been withdrawn from mining activities.

The sediments were analyzed at AcmeLabs in Vancouver. The concentrations of 53 elements were determined by inductively coupled mass spectrometry (ICP-MS) following digestion with *aqua regia* (a mixture of nitric and hydrochloric acids in a 1:3 ratio).

## Geochemical maps

Environmental factors (lake depth, amount of organic matter, pH, sediment colour) can affect the concentrations of certain elements in lake sediments (Trépanier, 2007). These factors are not considered within the scope of this report, and no statistical study

was carried out on the new data. The analyzed samples cover various geological domains or provinces (Figure 1; Lamothe and Simard, 2010), and the lithological nature of these geological divisions can affect sediment composition. The data were not processed or levelled in this regard, and potential geochemical anomalies may thus be masked by non-representative background noise.

The interpolation maps (Figures 3 and 4) were generated using the natural neighbour function in the Spatial Analyst tool of ArcGIS. The raw data were converted into percentiles, and cells of 250 by 250 metres were generated to compose the raster image. Note that the maps share a single legend that preferentially emphasizes higher percentile values (0.90 and higher).

## Gold

Twenty-seven lake sediment samples yielded anomalous gold values above 15 ppb (99.1<sup>st</sup> percentile), of which three contained more than 200 ppb (Table 1). New analyses were requested for these three samples, which returned values at or below the detection limit (Table 1; analyses from January 2012). Given the non-reproducibility of these results, we then decided to re-evaluate all anomalous samples with values above 15 ppb (Table 1; analyses of February 2012). The results revealed low concentrations, near or below the detection limit, with the exception of three samples that yielded values of 12, 15 and 20 ppb.

We attribute the non-reproducibility of the results to the nugget effect rather than contamination. This hypothesis is supported by the small amount of material used for the ICP-MS method (0.5 gram), compared to the fire assay method (30 grams). The results for several other elements also lead us to believe that sample contamination is unlikely. Firstly, a third of the 27 samples returned elevated arsenic and antimony values (> 90<sup>th</sup> percentile), two elements known to behave like gold. Secondly, the samples were collected over 17 different days and during 21 separate traverses. Thirdly, the 27 samples were analyzed by a laboratory using 12 of the 17 separate processing sequences employed for the full collection of 2,957 survey samples. Moreover, the samples analyzed immediately before the anomalous samples during these sequences returned systematically low values (< 5 ppb for 24 of the 27 samples).

Figure 2 shows the distribution and concentration of gold in lake sediments. These results are from the first set of analytical results obtained in December 2011 before the nugget effect issue had been raised. Results are also presented for a till survey carried out in the 1990s. The till sampling density was low: about one sample per 200 km<sup>2</sup> (Daigneault, 1997). The larger triangles represent results exceeding 25 ppb gold (till fine fraction, neutron activation method), corresponding to the 95<sup>th</sup> percentile for the 255 till samples available for this region.

**Areas of interest 1 and 2** (Figure 2) are located in the northern part of the region, near the Hudson Strait, and are underlain by rocks of the Kovik Antiform (Figure 1). They contain the highest gold values obtained during the survey. Area 1 includes a sample that returned 980 ppb gold (Table 1), at a distance of 4.7 km from a till sample containing 26 ppb gold. Area 2 contains a sample with 293 ppb gold at a distance of 8.9 km from a till sample containing 49 ppb gold. To the southwest, **area of interest 3** is located at the contact between the Archean rocks of the Kovik Antiform and the supra-crustal rocks of the South Domain (Figures 1 and 2). It includes two samples, 4.7 km apart, containing 17.5 and 19.8 ppb gold (Table 1). The Anore showing is about a dozen kilometres to the south-southwest of these samples.

**Area of interest 4** is in the southern part of the North Domain (Figure 2), associated with volcanic rocks of the Parent Group and intrusive rocks of the Cape Smith Suite. This zone contains three samples with values of 19.6, 32.8 and 110.7 ppb gold (Table 1). Four gold deposits and showings are also present in this area: Gerfaut-1, Goshawk, Goshawk Ouest and Goshawk Sud. **Area of interest 5** is also in the North Domain, associated with intrusive units of both the Watts Group and Cape Smith Suite. The area contains two samples, 3.1 km apart, with values of 17.8 and 216.1 ppb gold (Table 1). It also includes a till sample with 33 ppb gold about a dozen kilometres to the east.

**Area of interest 6** lies in the northeast part of the South Domain and is associated with volcano-sedimentary rocks of the Chukotat Group. This area includes a sample with 49.8 ppb gold (Table 1), at a distance of 4.6 km from a till sample containing 26 ppb gold. Finally, **area of interest 7** is in the Superior Province where two samples, 3.8 km apart, returned values of 17 and 21 ppb gold. These samples are from two lakes about a dozen kilometres north-northwest of the Nantais 1 and Nantais 2 showings (Madore *et al.*, 2001). If we also consider three lake sediment samples from an earlier survey to the south (Project 1997520; values of 18 to 26 ppb gold by neutron activation), then these two samples may be part of a NNW-trending gold-anomaly

axis 20 km long. Mining titles have been granted for the area containing the Nantais 1 and 2 showings to the south of area 7.

## Nickel and platinum group elements (PGE)

Figure 3a shows the nickel concentrations for lake sediment samples, as well as those with anomalous PGE values. Approximately 96% of the samples yielded values below the detection limit for palladium (10 ppb Pd), and 89% returned values below the detection limit for platinum (2 ppb Pt). We therefore compiled the samples having the highest values for one of these two elements ( $\geq 99.5^{\text{th}}$  percentile) as long as the other element is above the detection limit. The resulting PGE-anomalous samples presented in Figure 3a correspond to the following values: Pd  $\geq 24$  ppb and Pt  $> 2$  ppb or Pd  $> 10$  ppb and Pt  $\geq 9$  ppb.

The great majority of known nickel deposits and showings in this region occur in the South Domain and are associated with ultramafic intrusions of the Esker Lake Suite, which crosscuts the volcano-sedimentary rocks of the Povungnituk and Chukotat groups. These prospective areas are almost entirely covered by mining titles and are thus not discussed as areas of interest. It should be pointed out that several nickel deposits, including the Raglan mine, are found in the area marked "without samples" in Figure 3a. Elevated nickel values and several samples with anomalous PGEs are found here and there in this area. Their overall ENE trend may be attributed to the nickeliferous ultramafic units immediately to the south. If this is the case, we can infer a glacial displacement on the order of 5 kilometres for this region. Further south, the sampled lakes in the area of the Explo-Ungava project yielded much lower nickel values, between the 60<sup>th</sup> and 94<sup>th</sup> percentiles. Higher levels, in the 98.9 to 99.9<sup>th</sup> percentile range, are present along the same series of deposits and showings, 25 kilometres to the west-southwest. Finally, a series of four lake samples with high PGE values not accompanied by high nickel values, are aligned along the southern portion of the South Domain. These samples are found between 5 and 10 kilometres to the south of a series of Ni-Cu  $\pm$  PGE deposits and showings.

**Area of interest 8** is located in a zone marked by high nickel concentrations, above 289 ppm ( $>99^{\text{th}}$  percentile), as well as a single sample with anomalous PGEs. This area of interest straddles rocks of the North Domain and Kovik Antiform. The high values may reflect the presence of peridotite units belonging to the Watts Group in the North Domain. Only the three known deposits south of area 8 are currently covered by mining titles. Further to the east is **area of interest 9**, which also represents high nickel concentrations.

The known geological units in this area are varied and include gabbros of the Cape Smith Suite, sedimentary rocks of the Spartan Group, and volcanic rocks of the Parent Group.

## Copper

Figure 3b displays copper concentrations in lake sediments, as well as copper deposits not associated with nickel mineralization. **Area of interest 10** is located in the northern part of the North Domain, near the Narsajuaq Arc. It is characterized by strong copper values, but also strong silver and mercury values (400 to 770 ppm copper; 690 to 1500 ppb silver and 170 to 500 ppb mercury). Moreover, this area of interest also contains several anomalous gold values ranging from 5 to 23 ppb (Figure 2). Finally, a rock sample collected in this area in 1984 graded 2,400 ppm copper, although its location was never covered by an exploration permit. **Area of interest 11** is located in the northwest part of the North Domain, at the contact of the Narsajuaq Arc, near the Kovik Antiform (Figure 1). It displays several similarities to area 10, but anomalous silver, mercury and gold values are less abundant. The Lac Chasse-Est volcanogenic massive sulphide deposit, currently covered by exploration permits, is directly to the south (Figure 3b).

## Yttrium and uranium

Figure 4a displays yttrium concentrations. Yttrium is an excellent regional tracer element for finding hyperalkaline intrusive complexes. For example, the Mistastin Batholith, host to the Strange Lake and Misery Lake deposits, is associated with numerous lake sediment samples with values above 60 ppm. In our region of coverage, only 9 samples yielded values above 60 ppm yttrium, which leads us to believe that the potential for discovering this type of mineralization in the area is low. Nevertheless, we have identified three areas of interest that may be associated with other economic settings.

**Areas of interest 12 and 13** contain yttrium values above the 99.5<sup>th</sup> percentile (>53 ppm) coupled with elevated uranium values (>99.5<sup>th</sup> percentile, or >23 ppm). This combination of elements is typical of disseminated U-Th-REE mineralization related to Neoproterozoic granitic pegmatites (Cuney and Kyser, 2009). **Area of interest 12** is located in the Superior Province and

contains two REE showings associated with carbonate rocks (Labbé *et al.*, 2003), as well as a Cu-Ag showing associated with mineralized quartz veins (Madore *et al.*, 2001). The NE alignment of area 12, defined by interpolating the uranium data (Figure 4b), corresponds to ductile shears along which granodiorite and granite intrusions were emplaced (Madore *et al.*, 2001). This area of interest is available for exploration, with the exception of two rare earth showings currently covered by exploration permits (Figure 4a).

**Area of interest 13** is located in Archean rocks of the Kovik Antiform (Figure 4), where slices of Paleoproterozoic amphibolites have been mapped. It is associated with elevated yttrium and uranium concentrations (Figure 4). Finally, **area of interest 14** is located in the Narsajuaq Arc, near the contact with the Kovik Antiform. Here we find elevated yttrium and uranium values, in addition to high copper values (Figure 3b): a typical element suite associated with IOCG-type deposits.

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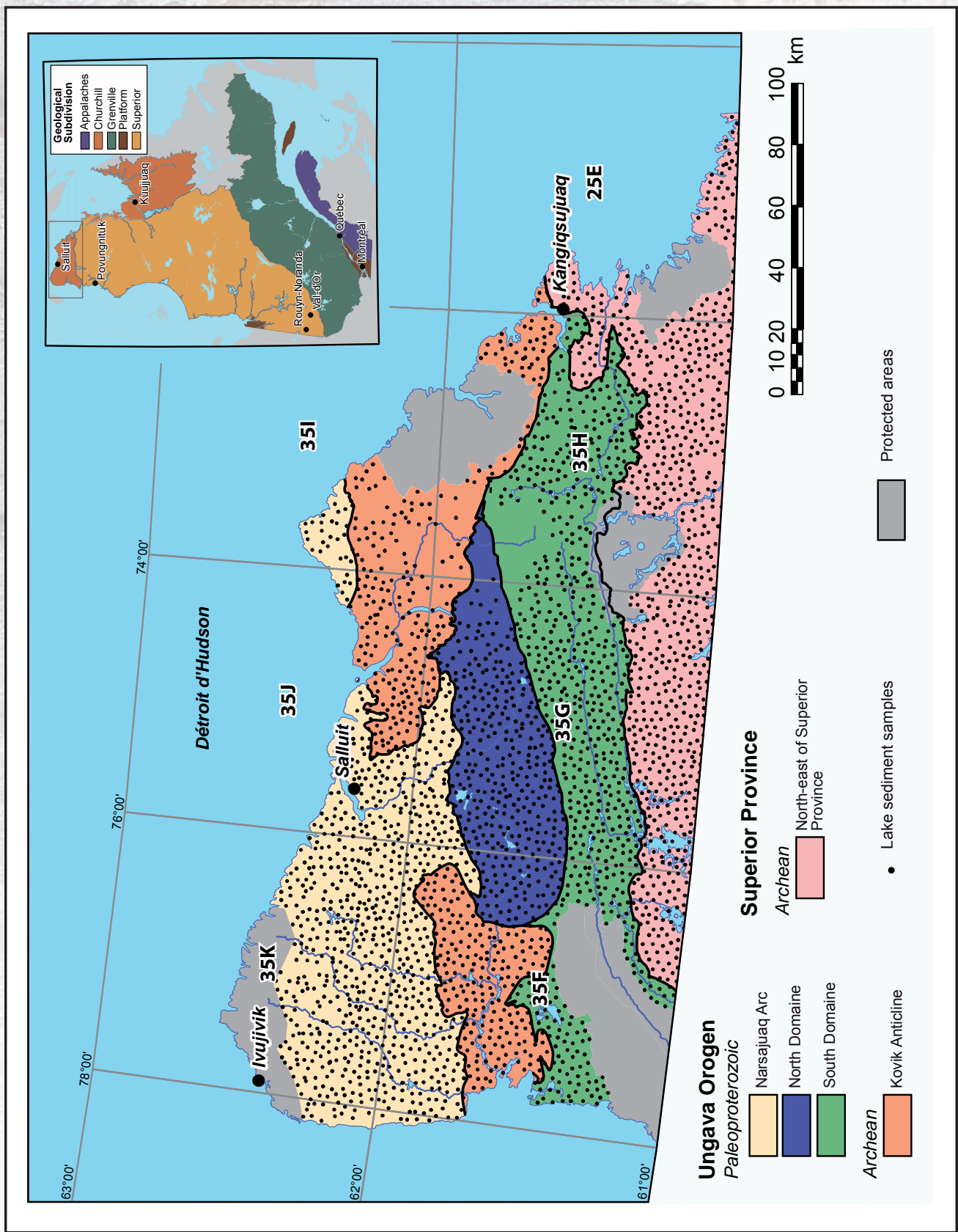
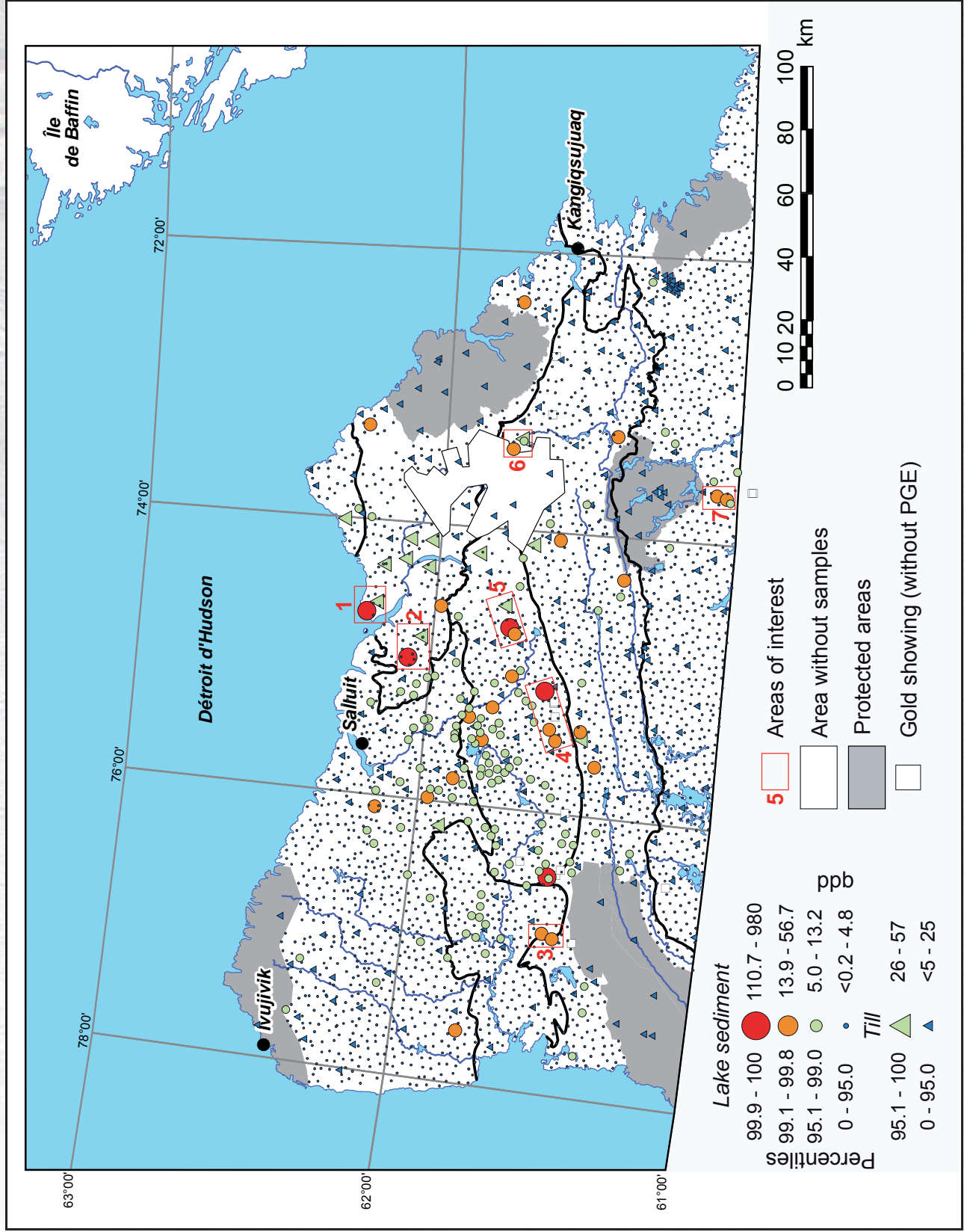
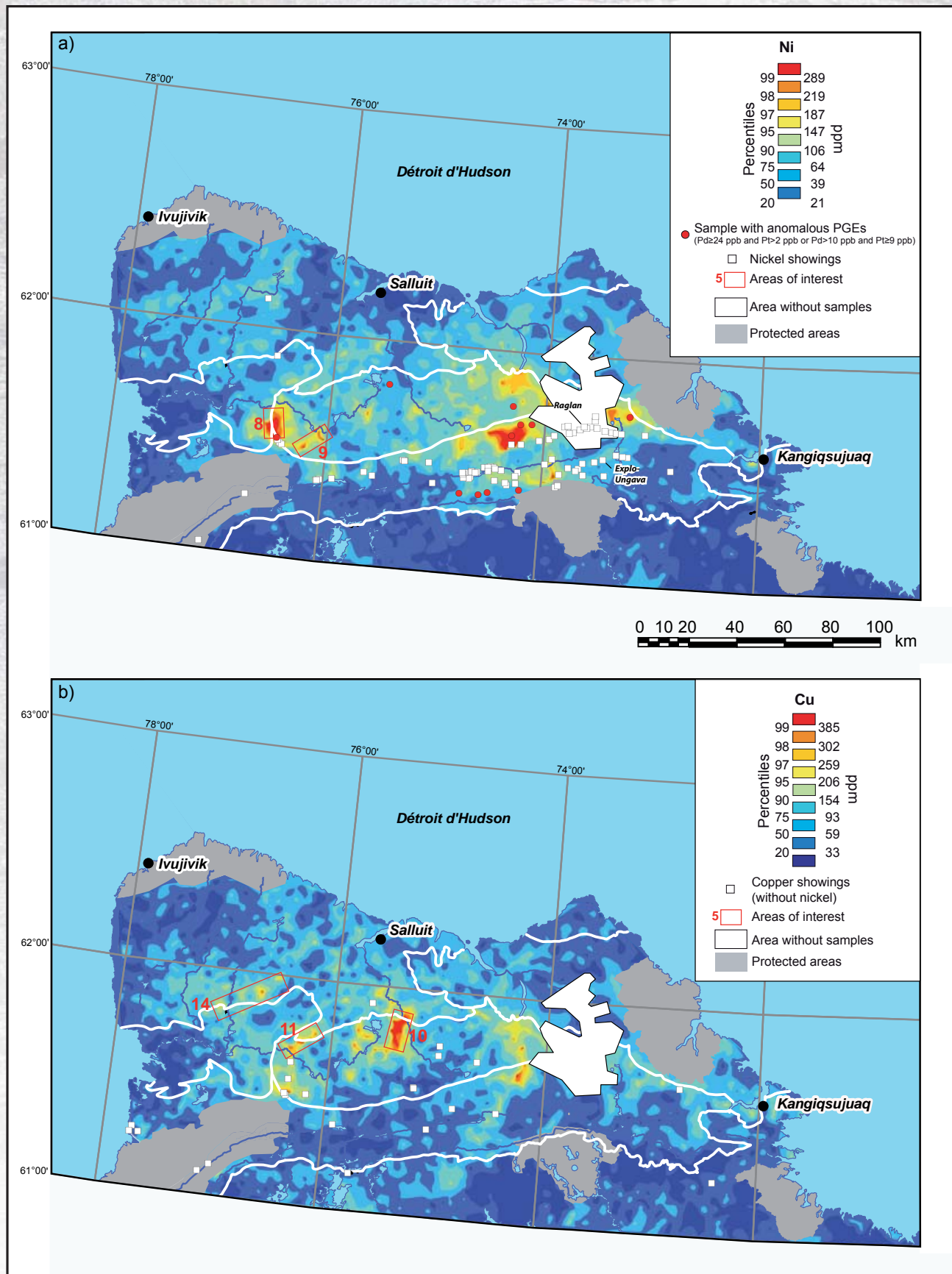


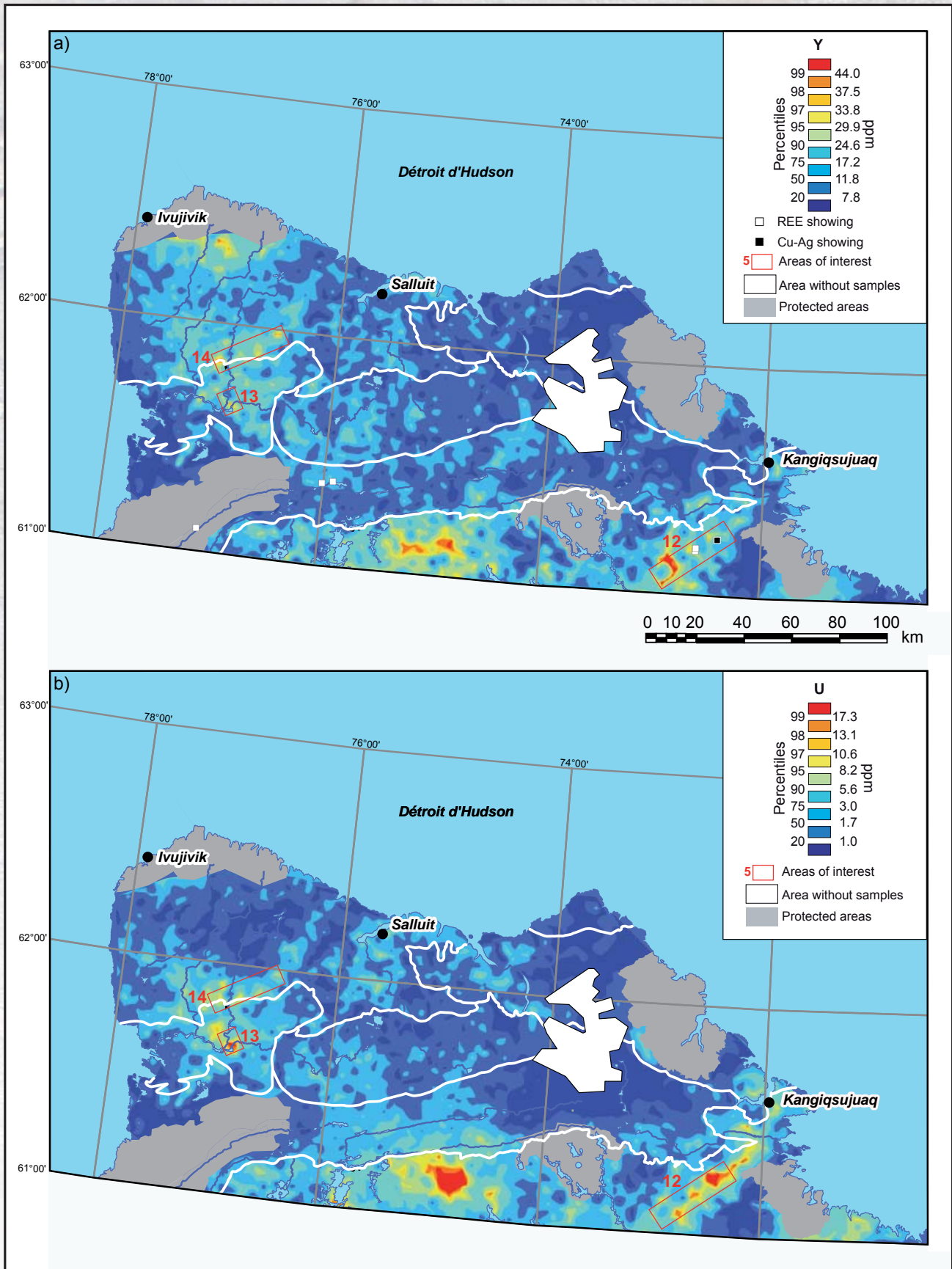
FIGURE 1 – Major geological divisions in the region, and the location of the survey.



**FIGURE 2** – Distribution of gold concentrations in lake sediment samples from this survey, and in till samples from a previous survey. Also indicated are gold deposits and showings not associated with PGEs.



**FIGURE 3 – a)** Map of nickel concentrations and anomalous platinum group element (PGE) values in lake sediments. Nickel deposits and showings are also indicated. **b)** Map of copper concentrations in lake sediments and the locations of copper deposits and showings not associated with nickel.



**FIGURE 4 – a)** Map of yttrium concentrations and the locations of rare earth element (REE) showings, as well as a copper-silver showing. **b)** Map of uranium concentrations in lake sediments.

**TABLE 1** – Lake sediment samples with anomalous gold values exceeding 15 ppb (99.1st percentile) that were first analyzed in December 2011 (0.5 gram of sample analyzed by ICP-MS) and then re-analyzed in January and February 2012 (30 grams by fire assay). N.A.: non-analyzed sample (two samples in the February batch still have not been analyzed at the time of this report); I.S.: sample not analyzed due to an insufficient quantity of material.

Sample	December 2011				January 2012 Au (ppb)	February 2012 Au (ppb)
	Au (ppb)	Au (percentile)	As (percentile)	Sb (percentile)		
2011114325	980.1	100	<70	<70	<2	2
2011116821	293.4	100	92	<70	<2	<2
2011115346	216.1	99.9	83	92	2	5
2011116365	122.7	99.9	91	99	N.A.	5
2011114560	110.7	99.9	<70	<70	N.A.	<2
2011115191	56.7	99.8	<70	70	N.A.	3
2011116179	49.8	99.8	92	<70	N.A.	<2
2011116440	47.1	99.8	<70	<70	N.A.	<2
2011114368	37.1	99.7	<70	<70	N.A.	<2
2011115457	32.8	99.7	92	96	N.A.	<2
2011115454	30.1	99.7	<70	93	N.A.	3
2011114555	23.3	99.6	78	70	N.A.	I.S.
2011115542	23.0	99.6	<70	<70	N.A.	3
2011116696	20.8	99.6	83	<70	N.A.	N.A.
2011115256	20.5	99.5	88	88	N.A.	15
2011115640	20.3	99.5	83	70	N.A.	<2
2011116118	20.1	99.5	<70	<70	N.A.	3
2011115820	19.8	99.4	<70	76	N.A.	4
2011115316	19.6	99.4	91	96	N.A.	12
2011114551	18.8	99.4	<70	75	N.A.	I.S.
2011114757	18.4	99.3	<70	<70	N.A.	I.S.
2011115213	17.8	99.3	70	83	N.A.	<2
2011115786	17.5	99.3	<70	80	N.A.	<2
2011113872	17.3	99.2	<70	<70	N.A.	<2
2011115248	17.2	99.2	<70	<70	N.A.	20
2011114964	16.1	99.2	91	88	N.A.	3
2011116844	15.1	99.1	95	81	N.A.	N.A.



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