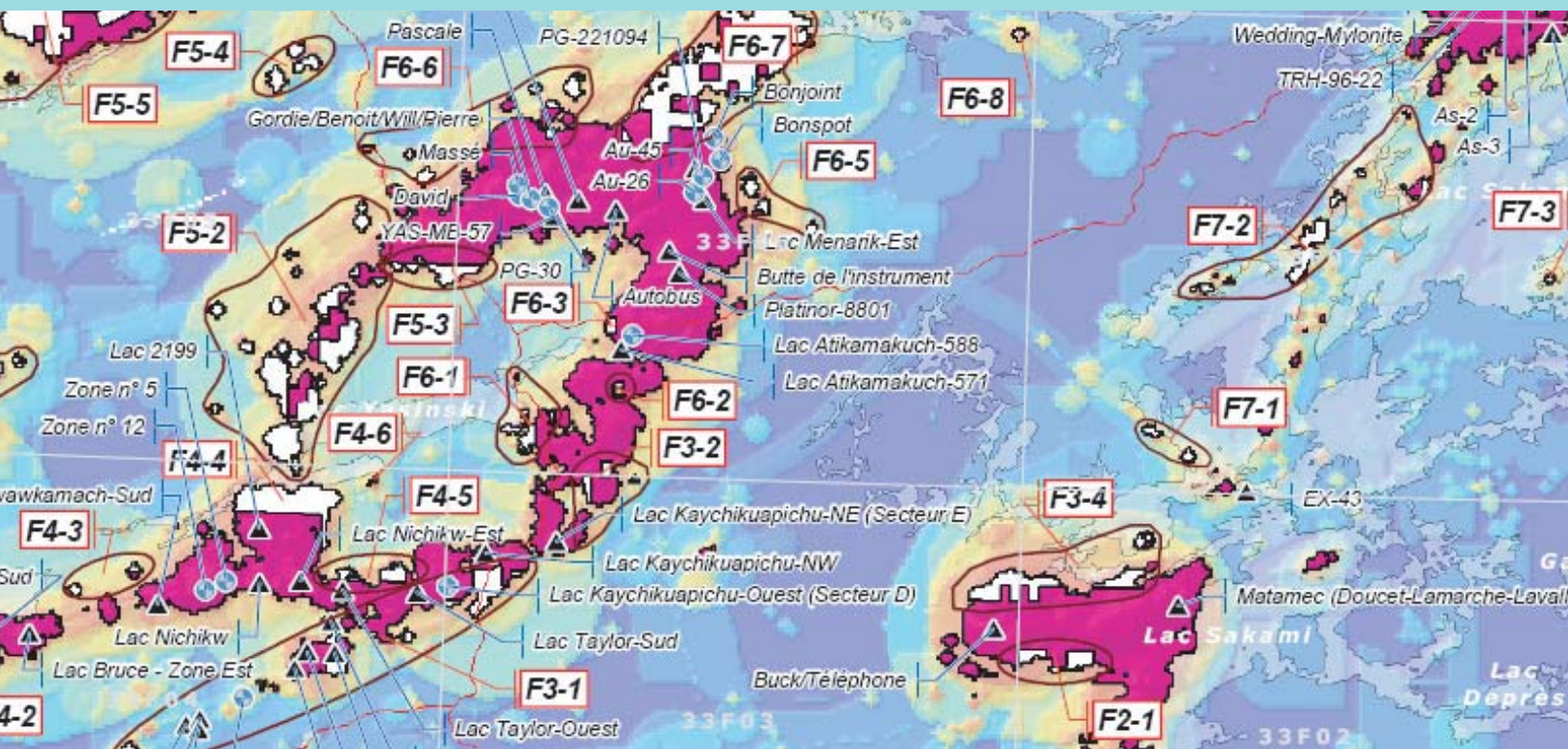


Assessment of the potential for orogenic gold deposits in the Baie-James region



Daniel Lamothe

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Abstract

The aim of this study was to determine the location of high-favourability zones for orogenic gold deposits in the Baie-James region. It describes 114 potential gold occurrences that were unstaked at the time of the study. High-favourability zones are defined using 23 parameters in 5 broad classes: 1) lithological control; 2) structural control; 3) hydrothermal alteration; 4) geophysical evidence; and 5) favourable secondary environment.

The geological significance of each parameter is evaluated by the weights-of-evidence spatial analysis method. This technique is used to measure the degree of spatial association between a given parameter and the location of known occurrences. For each parameter, a map representing the weighted association with significant gold deposits in the Baie-James region was produced. The weightings were converted into fuzzy values and the parameters were combined using a hybrid fuzzy logic approach. The result is an overall favourability map of orogenic gold deposits in the Baie-James region, available at 1:500,000 scale in PDF, GeoTIFF and ArcGIS raster format. The map is also available through Québec's mining titles management system (GESTIM).

A minimal favourability threshold value for defining high-favourability zones was determined using a statistical approach. These zones encompass 97.6% of the 84 mines, worked gold deposits and deposits with a tonnage estimate in the Baie-James. From these zones, the author eliminated the sectors that were staked as at February 6, 2008, thereby identifying 114 new exploration targets. The assessment of favourability, the high-favourability zones and the targets are shown on six 1:250,000-scale maps as well as on fifty-one 1:50,000-scale maps available in PDF format on CD-ROM. Each target on a map is linked to a database containing a large amount of valuable information for assessing potential. The grid and vector data used to prepare the document are also provided on the CD-ROM.

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INTRODUCTION

The advent of GIS (geographic information system) platforms in the early 1990s led to the development of approaches for processing and combining a variety of geological parameters in order to define zones favourable for the exploration of economic minerals (see Chung and Agterberg, 1980; Bonham-Carter et al., 1988; Harris, 1989; Agterberg et al. 1990; Chung and Moon, 1991; Bonham-Carter, 1994; Rencz et al., 1994; Harris et al., 1995; Wright and Bonham-Carter, 1996; Singer and Kouda, 1997a,b; Raines, 1999; Harris et al., 2001; Brown et al., 2000; D’Ercole et al., 2000; de Araujo and Macedo, 2002; Porwal et al., 2003a,b). A number of assessment studies based on georeferenced data integration have been published for several ore deposit models, specifically:

- volcanogenic massive sulphide (VMS) deposits (Wright and Bonham-Carter, 1996; Dion and Lamothe, 2002; Lamothe et al., 2005);
- orogenic gold model (Lamothe and Harris, 2006; Rogge et al., 2006; Harris et al., 2001; Groves et al., 2000; Knox-Robinson, 2000);
- epithermal gold deposits (Boleneus et al., 2001);
- Mississippi Valley-type deposits (D’Ercole et al., 2000);
- Olympic Dam-Kiruna-type deposits (Lamothe and Beaumier, 2001 and 2002);
- kimberlite potential (Wilkinson et al., 2006; Labbé, 2002; Paganelli et al., 2002);
- mineral potential for porphyry-type Cu-Au-Mo deposits in the Abitibi (Labbé, Pilote and Lamothe, 2006).

There are several steps in the production of a mineral potential map (Figure 1). First, an appropriate exploration model (e.g. VMS, or orogenic gold) must be selected for the targeted mineral(s). Using this model, geological parameters are chosen and combined to create a **favourability**¹ map. This step is crucial because it enables the modeller to evaluate the availability of sources of georeferenced data for each parameter and to calculate the time it will take to acquire new data sources, if needed. It is also during this step that an appropriate geodetic reference system and map projection will be chosen.

The second step consists in producing, for each parameter selected, a **digital evidence map**¹, which will be integrated when processing the exploration model. The map format is either binary (0 or 1), multi-class or continuous (see Harris et al., 1999, 2000, 2001). This processing step generally requires the use of spatial analysis or statistical processing software which is usually available as a GIS extension.

The third step involves integrating the diverse evidence maps in order to produce a favourability map. The integration approaches fall into two categories (Table 1): data-driven methods and knowledge-driven methods (see Bonham-Carter (1994) and Wright and Bonham-Carter (1996) for a detailed review). In order to use data-driven approaches, a sufficient number of mineralized zones of the type sought must be present in the study area. These methods analyse the spatial relationships between the evidence data (parameters) and the location of known deposits, allowing a weight to be assigned to each evidence map. The “weights-of-evidence” method (WofE) (Bonham-Carter, 1994), logistic regression (Chung and Agterberg, 1980) and neural network analysis (Singer and Kouda, 1996, 1999; Harris and Pan, 1999; Brown et al., 2000) are data-driven methods (Table 1).

¹-This term has come into increasing use in the scientific literature.

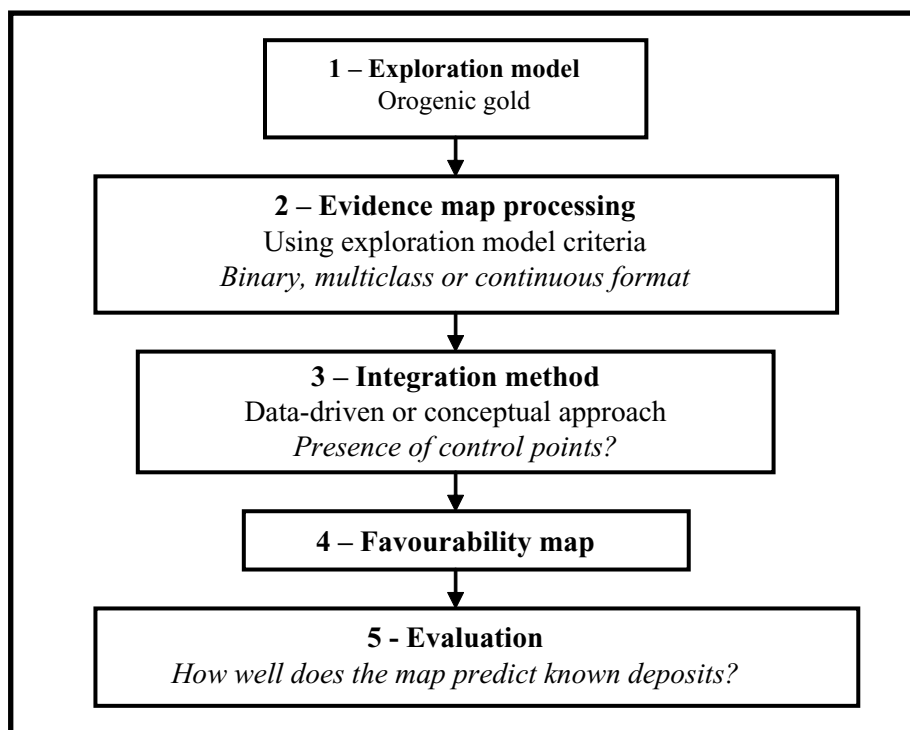


Figure 1 - Steps in creating a favourability map through georeferenced data integration (modified from Harris et al., 2005)

Table 1 - Methods of integrating evidence maps in a GIS environment.

Method	Processing	Combination Criteria
Data-driven methods		
Weights of evidence (<i>WofE</i>)	Control points (known deposits or occurrences)	Determination of the spatial relationship between known occurrences and the variables being tested (use of Bayes' Theorem)
Logistic regression	Control points (known deposits or occurrences)	Use of spatial zones around known deposits to determine the statistical criteria for applying data layers to predict the presence or absence of mineral deposits
Neural networks	Control points (known deposits or occurrences)	Reproduction of an anomalous assemblage (i.e. deposits) through a shape recognition process
Knowledge-driven methods		
Boolean operations	Input of the geologist	Sum of binary maps
Multi-layer overlay	Input of the geologist	Sum of weighted binary maps
Inference network and decision tree used in an expert system	Input of the geologist	
Dempster-Shafer belief theory	Input of the geologist	
Fuzzy logic	Input of the geologist	Each prediction map is assigned a fuzzy weighting factor ranging from 0 to 1; maps are combined using a fuzzy operator (and, or, gamma)
Analytic Hierarchy Process (AHP)	Input of the geologist	Sum of weighted favourability (continuous maps)

Knowledge-driven (conceptual) approaches harness the modeller's expertise in assigning weight factors to the individual evidence maps based on the exploration model. Although subjective, these methods allow the geologist's knowledge and experience to be incorporated into the procedures. They include Boolean logic, multi-layer overlay (Harris, 1989), Dempster-Schafer belief theory functions (Chung and Moon, 1991; An et al., 1992) and fuzzy logic (An et al., 1991).

It is possible to develop hybrid models that combine the data-driven and knowledge-driven approaches. For example, to assess the potential for SEDEX deposits in India (Porwal et al., 2003b) or VMS deposits in the Abitibi (Lamothe et al., 2005), these authors used the weights-of-evidence approach to weight the parameters, converting these values into fuzzy weights and combining the evidence maps using fuzzy logic (the same approach is used in the present study). In another case, Brown et al. (2003a) weighted evidence maps using fuzzy logic and combined them using neural networks in order to assess the orogenic gold potential of Western Australia.

The result of the integration process is a georeferenced map of potential illustrating zones of high favourability for the type of mineral resource sought. In addition to correctly predicting the presence of known deposits, the map should also identify new exploration zones. The credibility of such a map is dependent on the effective measurement of favourability; counter-validation techniques are used to confirm the reliability of the method. This validation step is important and should be integrated into any serious assessment of mineral potential.

Study objectives

The purpose of the present study was to determine the location of high-favourability zones for orogenic gold deposits in the Baie-James region (Figure 2). Although many of these zones are already staked, the aim was to define a number of unstaked targets and to provide a maximum of data to facilitate the assessment of each target. This will enable mining industry stakeholders to capitalize on the study findings quickly, while also allowing the author to evaluate the benefits of the study by determining the number of targets staked after it is published.

The second goal was to determine the usefulness and credibility of this type of approach by assessing the predictive value of the favourability map produced in the study as well as its ability to recognize the presence of a control set made up of gold-bearing deposits not used during the processing.

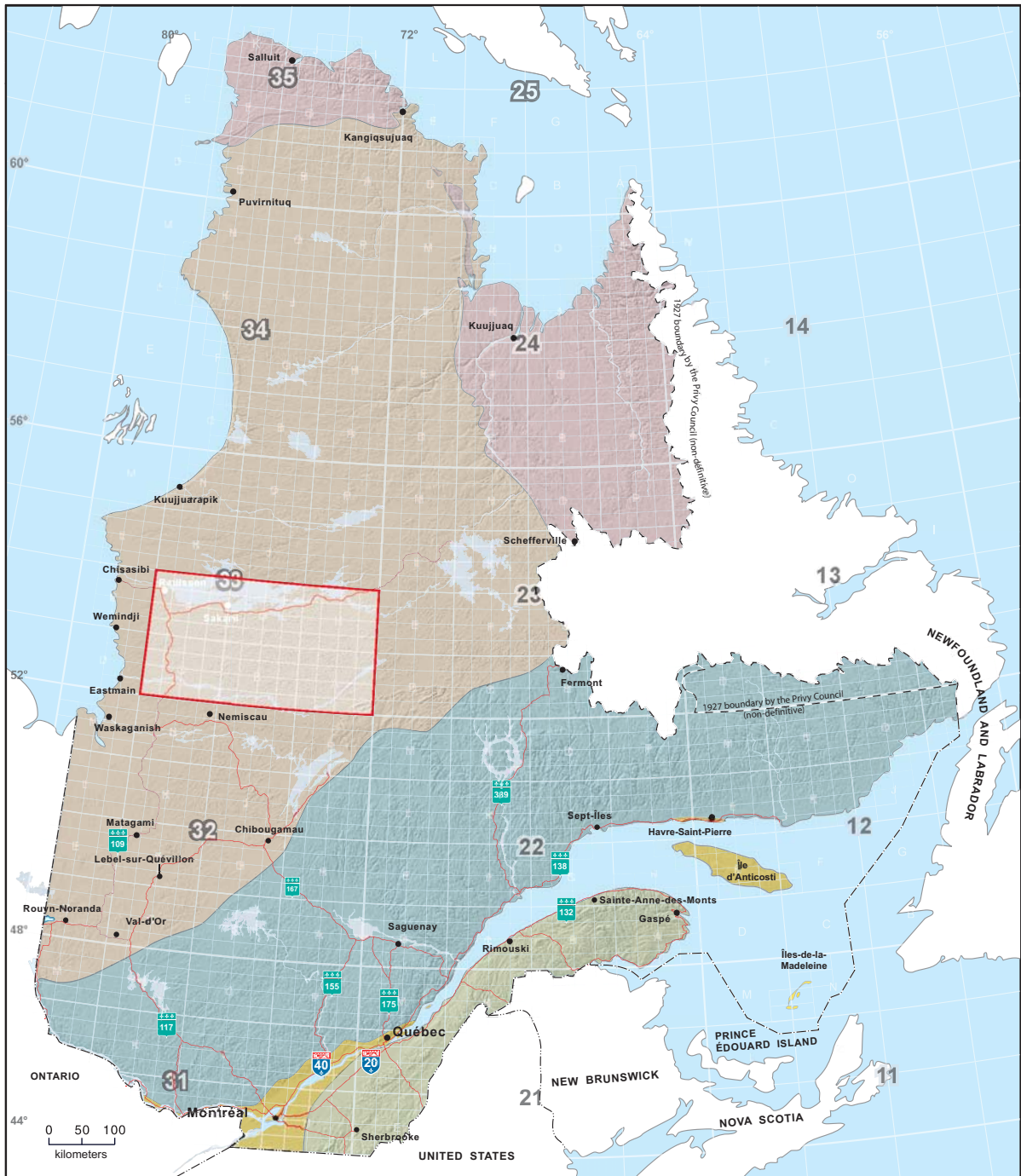


Figure 2 - Location of the study area.

General geology

The study area is located in the Superior Province (Figure 3), which is divided into four main Archean subprovinces: 1) the **Nemiscou subprovince**, in the southwestern corner of the region, consisting primarily of metasedimentary rocks (Card and Ciesielski, 1986); 2) the northeastern domain of the **Opatika subprovince**, in the southeastern corner of the region, composed primarily of gneissic plutonic rocks and metavolcanic rocks (Hocq, 1994); 3) the **Opinaca subprovince**, composed of typically migmatitic detritic metasediments; and 4) the **La Grande subprovince**, characterized by a volcano-plutonic assemblage. The region also comprises remnants of Proterozoic sedimentary rocks of the Sakami Formation (northern part of the region), as well as of the Mistassini basin (in the southeastern corner) (map A5.1 in Appendix 5). The La Grande and Opinaca subprovinces together account for more than 90% of the area of the region of interest.

The La Grande rocks are comparable to those of the Sachigo-Uchi-Wabigoon subprovinces of northwestern Ontario (Goutier et al., 2002). The subprovince comprises two volcanic belts (Figure 3): 1) the **La Grande volcanic belt**, situated in the northern part of the subprovince, which comprises two temporally and lithologically distinct volcanic cycles (Yasinski Group: $2736 \pm 8/-6$ Ma and Guyer Group: 2820.3 ± 0.8 Ma) (Yasinski: basaltic to rhyolitic without komatiite vs Guyer: komatiites, basalts and felsic tuffs) (Goutier et al., 2002); and 2) the **Middle and Lower Eastmain greenstone belt**, located in the southern part of the La Grande subprovince, which comprises four volcanic cycles (cycle 1: 2752-2739 Ma; cycle 2: 2739-2720 Ma; cycle 3: 2720-2705 Ma; and cycle 4: <2705 Ma) (Moukhsil et al., 2003).

The Opinaca subprovince is related to the English River and Quetico subprovinces of northwestern Ontario (Goutier et al., 2002). It is dominated by the Laguiche Group, composed primarily of locally migmatitic paragneisses derived from a thick sequence of feldspathic wacke. There are also many locally pegmatitic granite intrusions, along with quartz monzodiorite or tonalite intrusions. In the western part of Opinaca, the group's age has been estimated at 2648 ± 50 Ma based on detrital zircons from a polygenic conglomerate (Goutier et al., 2002). In the easternmost part of Opinaca, the youngest age of the paragneisses is estimated at 2730 Ma (Percival et al., 2003).

The transition between the two subprovinces has been interpreted by Gauthier and Larocque (1998) and by Franconi (1978) as a stratigraphic contact marked by a steep metamorphic gradient. This interpretation is in agreement with the observations made by the present author in the easternmost portion of Opinaca. Although the contact between the two units is typically characterized by faulting, Goutier et al. (2002) have postulated the existence of a sedimentary hiatus on the basis of the significant age differences between the two units.

The metamorphism characterizing the La Grande subprovince ranges from greenschist to upper amphibolite facies, whereas the rocks of the Opinaca province are characterized essentially by upper amphibolite and granulite facies (Figure 4). The degree of metamorphism is a key factor in the region's potential for gold, given that there are few, if any, large deposits in granulite facies rocks around the world (Robert et al., 2005).

The gold deposits used in this study (re: "Parameters" section) to weight the parameters and validate the results are located mostly in the La Grande subprovince, with exception of deposits 1 to 5 (map A5.1 in Appendix 5), which are located in the Opatika subprovince.

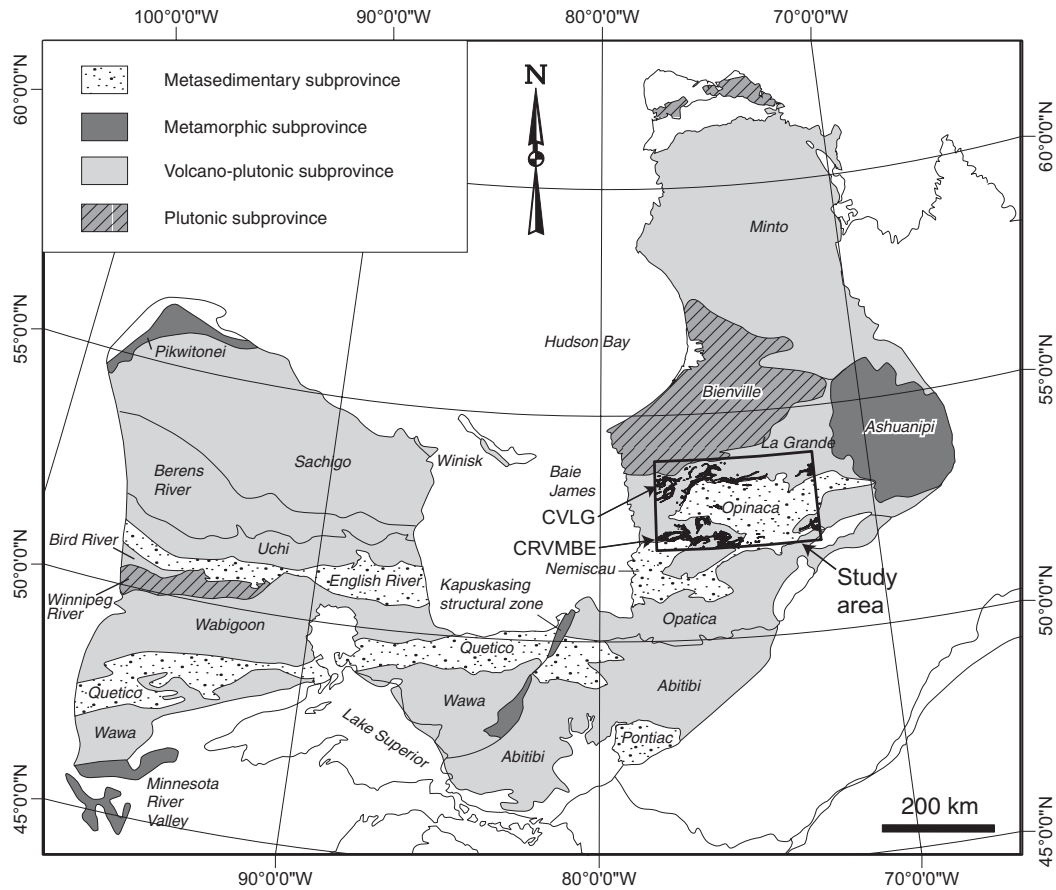


Figure 3 - Map of the main subdivisions of the Superior Province. The base map is from Card and Ciesielski (1986) and Thurston (1991), and was subsequently modified by Gauthier et al. (2002). CVRMBE = Middle and Lower Eastmain greenstone belt; CVLG = La Grande volcanic belt.

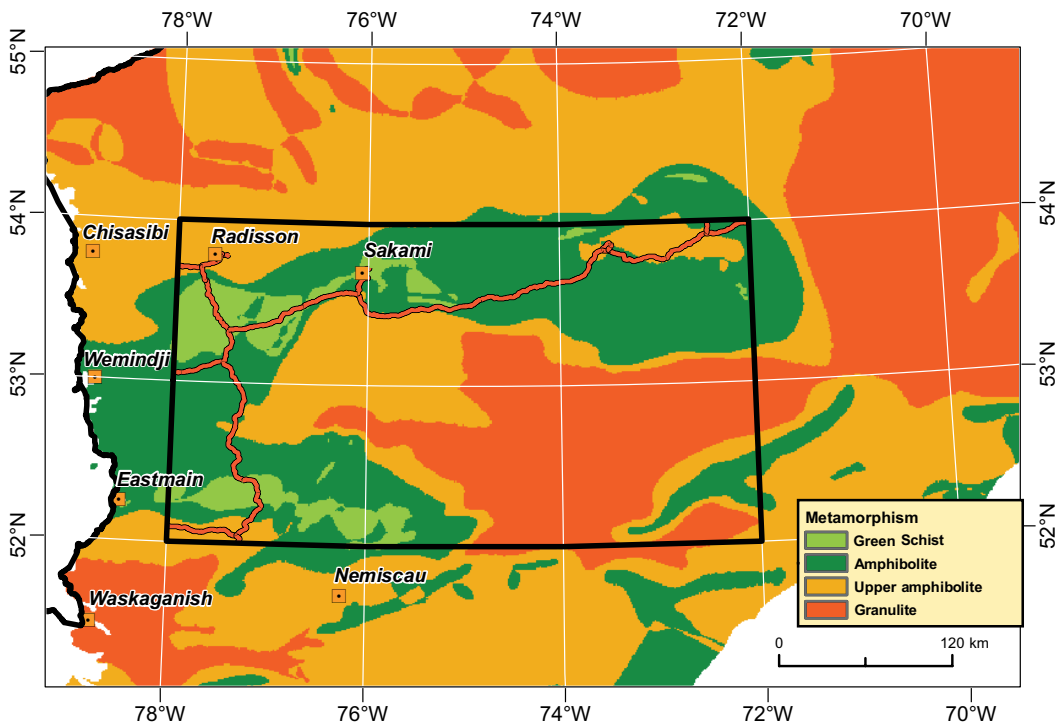


Figure 4 - Metamorphic map of the Baie-James region (Gauthier et al., 2007).

METHODOLOGY FOR ASSESSING FAVOURABILITY

Introduction

The processing methods fall into two broad categories (Table 1): 1) data-driven methods, which are based on the analysis of spatial relationships between known mineral occurrences and certain geological parameters; the best known data-driven methods are the weights-of-evidence (WofE) approach and neural network analysis; and 2) knowledge-driven methods, which are generally used in the absence of known deposits in the study area and which require that a geologist determine the relative weighting of each parameter. The fuzzy logic approach is the most widely used knowledge-driven method, primarily because of its flexibility and its simplicity.

Some recently developed hybrid approaches combine the flexibility of knowledge-driven methods and the rigour of data-driven methods (Brown et al., 2003a; Porwal et al., 2003). For example, the hybrid fuzzy logic method can be used to get around one of the main problems associated with WofE analysis: the assumption underlying Bayes' Theorem that all of the parameters are independent. This assumption is almost always violated when the method is applied in a geological context, given that several categories of data are obtained either directly or indirectly from one of the sources of evidence that is used in the modelling (e. g. contacts on a geologic map interpreted from a magnetic field map). Although the method is valid for measuring the spatial association of each parameter individually, violation of the conditional independence assumption usually produces excessively high values, such that, when the intermediate favourability maps are combined, posterior probability (resulting favourability) cannot be calculated properly. For this reason, it seems more appropriate to combine evidence maps weighted by the WofE method by applying a knowledge-driven method, that is, fuzzy logic (whence the name hybrid fuzzy logic).

The combining of data-driven and knowledge-driven approaches is particularly suitable for assessing the orogenic gold deposit potential of the Baie-James region because of the large number of deposits of this type present in the region, enabling: 1) data-driven calculation of the probability of spatial association between relevant parameters and these deposits; and 2) the use of fuzzy logic to combine the resulting evidence maps, thereby circumventing the conditional independence constraint for these parameters.

The selected approach was developed by Porwal et al. (2003), who put forward two fuzzy logic-based methods: a knowledge-driven fuzzy logic approach that harnesses the modeller's judgement in the assignment of fuzzy favourability values; and a data-driven fuzzy logic approach whereby fuzzy favourability values are established through probability calculations using the weights-of-evidence method. This second approach was determined to be the most promising one for this study, for the following reasons:

- The Baie-James region has more than 160 orogenic gold occurrences (most of which are well documented), permitting the use of the data-driven approach.
- The use of the weights-of-evidence method to calculate favourability eliminates the subjectivity inherent in the knowledge-driven approach which stems from the modeller's role in arbitrarily assigning a favourability value based on his own (sometimes mistaken) perception of the relevance of a given parameter.
- If unsuitable elements are incorporated into a set of objects (poorly defined ore bodies, imprecise fault location, etc.) making up a parameter, the WofE contrast value that is calculated for the spatial association will be weaker than what theoretically should be obtained. In fact, the inclusion of foreign elements that are not associated with orogenic gold occurrences will dilute the spatial association value and ultimately generate a weaker favourability value. The method therefore has an inherent tendency to underestimate the actual favourability of a parameter when an element is erroneously included. This property is a key advantage in terms of the reliability of the targets that are generated.
- The fuzzy logic method is the most flexible of all the favourability assessment methods. A variety of operators can be used to combine the different parameters, thereby adequately reproducing the expert knowledge entailed in assessing mineral resource potential.
- Unlike the weights-of-evidence method, the fuzzy logic approach does not require that the data used satisfy the conditional independence requirement, although this is desirable.

Methodology

Wright and Bonham-Carter (1996), Reddy et al. (1991) and Agterberg (1989) used the WofE approach to assess the potential for finding VMS deposits. It has also been used to assess the potential for orogenic gold deposits (Bonham-Carter et al., 1988; Porwal and Hale, 2000; Harris et al., 2001) and epithermal gold deposits (Turner, 1997; Carranza and Hale, 2000; Boleneus et al., 2001), as well as potential for porphyry-copper deposits (Carranza and Hale, 2002)².

This method, originally developed by Spiegelhalter (1986), was applied to mineral exploration by Bonham-Carter et al., (1988), Harris et al., (1995), Wright (1996), Wright and Bonham-Carter (1996) and Raines (1999). Under this approach, a set of evidence maps derived from geophysical, geochemical and geological data are combined to produce a favourability map using Bayesian statistics. The spatial association of each evidence map is calculated with reference to the location of known deposits. A pair of weight factors, W^+ and W^- , is calculated from the amount of overlap between known deposits and the various classes of the evidence map. If there is no particular association between the known mineral occurrences and the evidence map, then $W^+ = W^- = 0$. A positive W^+ indicates a positive association between known deposits and the evidence map. The contrast value ($C = [W^+] - [W^-]$) represents the degree of spatial association between the evidence map and the known occurrences. In the present document, a high C value (i.e. $C > 4$) for a class of values on an evidence map (for example, the class of cells located 200 m from a fault) indicates a strong association between known orogenic gold deposits and this particular class of values (Figure 5).

The hybrid fuzzy logic approach uses the weights-of-evidence method (re: previous section) to calculate the **favourability value** (V_{favor}) based on the contrast value (C), calculated using the formula below (Porwal et al., 2003)³. Equation (1) is used if the contrast value is positive. For a negative contrast value, equation (2) is used. If the contrast value is 0, the favourability value will be 0.5 for both equations.

$$V_{favor} = 0.5 + (C_{ij} / 2 \times C_{max}) \text{ if } 0 \leq C_{ij} \leq C_{max} \quad (1)$$

$$V_{favor} = 0.5 - (C_{ij} / 2 \times C_{min}) \text{ if } C_{min} < C_{ij} \leq 0 \quad (2)$$

C_{ij} = vcontrast value for class j of evidence map i

C_{max} = maximum contrast of the set of evidence maps

C_{min} = minimum contrast of the set of evidence maps

This approach, which resembles that used by Cheng and Agterberg (1999), applies the notion of **relative weighting of evidence maps** since it establishes the favourability value in relation to the full set of maps and classes used⁴. For the orogenic gold model applied to the Baie-James region, the C_{max} and C_{min} values are 8.724 and -7.136 respectively.

The different maps produced in processing the metallogenic model are combined using fuzzy operators, some of which are equivalent to Boolean operators. In this study, the FUZZYGAMMA (fuzzy GAMMA) operator and the operator OR are used. Use of the operator OR generates as output the maximum favourability value present on the combined maps. The FUZZYGAMMA operator enables the modeller to increase the degree of overlap of certain favourable parameters by generating a result greater than the maximum value of the cells of the combined maps. The FUZZYGAMMA operator is modulated using a gamma factor F whose value (generally between 0.85 and 0.97) is determined by the modeller depending on the increase in magnitude sought.

Inappropriate use of the FUZZYGAMMA operator at various stages in the combination process can result in artificial overweighting of the final assessment, since the application of a high F factor tends to increase the favourable values. To avoid this pitfall, the different factors of the FUZZYGAMMA operators used were calibrated to obtain a background value of about 0.5 in the final map. With

2- The Arc-SDM module, an extension of ArcView 3.x or ArcGIS 9.x, which is distributed free of charge by the Canadian Department of Natural Resources, can be used to calculate the different variables of the weights-of-evidence method. The list of parameters and a brief definition of the values calculated by the WofE method for each parameter is provided in Appendix 2.

3- The No Data values were replaced with favourability values of 0.001 to keep them from propagating in the final result when the favourability maps are combined.

4- One of the results of using this approach is that at least one of the classes in the parameters will have a favourability value of 1, whereas at least one other class will have a value of 0. This method has a drawback: it is not possible to create an intermediate favourability map for a predictive map until all the maps used in the model have been processed, because the favourability value that is calculated depends on the minimum and maximum contrast values obtained for the set of maps.

the present approach, this value represents an intermediate value between a favourable association (positive contrast) and an unfavourable non-association (negative contrast).

The final result of the process is a map of favourability values for the presence of orogenic gold occurrences. The process of integrating the different parameters (the inference network) is illustrated in Appendix 3. The parameters are grouped in blocks forming five submodels (Table 2): 1) the lithological control submodel; 2) the structural control submodel; 3) the hydrothermal activity submodel; 4) the geophysical evidence submodel; and 5) the secondary environment submodel. This grouping into submodels facilitates understanding of the process and interpretation of the results.

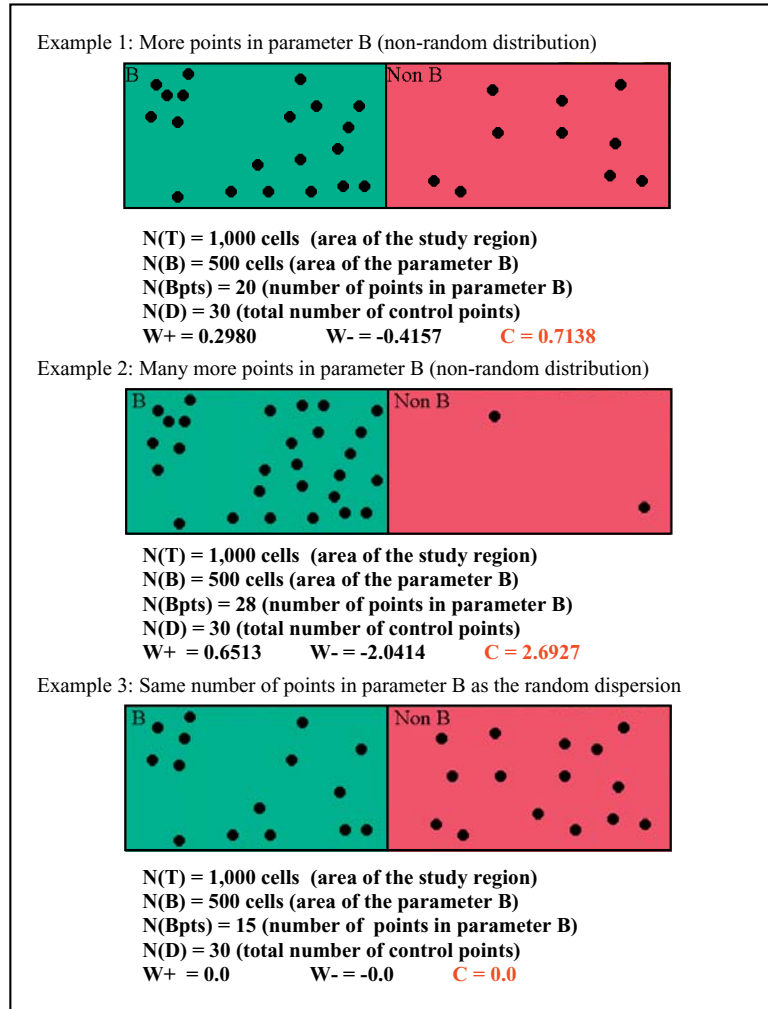


Figure 5 - Examples of calculation of the contrast value relative to the spatial association between control points and a parameter.

Parameters

The first step in any assessment of mineral potential consists in selecting parameters that will be effective predictors of orogenic gold deposits from all the possible geological parameters available in digital format for the study area. The weights-of-evidence method (Bonham-Carter et al., 1989; Harris et al., 2001; Lamothe et al., 2005) was used to evaluate the spatial association of the individual parameters to a set of orogenic gold deposits composed of mines, deposits with a tonnage estimate and worked deposits. Only those parameters with contrast values (C) greater than 1.5 were retained (Table 2). A few parameters, which are not included in Table 2, were tested and then eliminated because of their low contrast value (specifically, proximity to a fault deflection zone; proximity to a ductile lineament; proximity to traces of folds on maps and Landsat images; proximity to a Au, Ag, Mo, Hg, B, Tl, V or Ba lake sediments anomaly).

Table 2 - Parameters used to assess potential for orogenic gold deposits in the Baie-James region. All the digital data for individual parameters, combined maps and the final assessment map can be downloaded from the table by clicking on the appropriate hyperlink. The available formats are ESRI file format (SHP); ADOBE format (PDF); georeferenced TIFF (GeoTIF); and ESRI raster file (GRD).

Family of parameters		Parameters used	Digital files	Favourability map for orogenic gold deposits in the Baie-James PDF , GeoTIF , GRD
Lithological control PDF , GeoTIF , GRD		Reactivity	SHP , PDF , GeoTIF , GRD	
		Proximity to felsic dikes	SHP , PDF , GeoTIF , GRD	
		Proximity to a favourable lithology	SHP , PDF , GeoTIF , GRD	
		Lithological diversity	PDF , GeoTIF , GRD	
Structural control PDF , GeoTIF , GRD		Proximity to a local fault or shear zone	SHP , PDF , GeoTIF , GRD	
		Proximity to mapped Archean faults	SHP , PDF , GeoTIF , GRD	
		Density of mapped Archean faults	PDF , GeoTIF , GRD	
		Proximity to a local fold hinge	SHP , PDF , GeoTIF , GRD	
		Proximity to quartz veins	SHP , PDF , GeoTIF , GRD	
Hydrothermal activity PDF , GeoTIF , GRD	Indicator metals in rock PDF , GeoTIF , GRD	Proximity to a gold anomaly	SHP , PDF , GeoTIF , GRD	
		Proximity to a silver anomaly	SHP , PDF , GeoTIF , GRD	
		Proximity to an arsenic anomaly	SHP , PDF , GeoTIF , GRD	
		Proximity to an antimony anomaly	SHP , PDF , GeoTIF , GRD	
		Proximity to a boron anomaly	SHP , PDF , GeoTIF , GRD	
		Proximity to a molybdenum anomaly	SHP , PDF , GeoTIF , GRD	
	Lithochemical alteration indices SHP , PDF , GeoTIF , GRD	Proximity to an anomalous peraluminosity index	SHP	
		Proximity to an anomalous chlorite index	SHP	
		Proximity to an anomalous Hashimoto index	SHP	
		Proximity to an anomalous alkaline index	SHP	
	NORMAT index	Proximity to an anomalous potassium alteration	SHP , PDF , GeoTIF , GRD	
	Observed mineralization PDF , GeoTIF , GRD	Proximity to an alteration minerals observation	SHP , PDF , GeoTIF , GRD	
		Proximity to a local sulphide occurrence	SHP , PDF , GeoTIF , GRD	
Geophysical evidence PDF , GeoTIF , GRD		Proximity to a favourable value for the residual magnetic field	PDF , GeoTIF , GRD	
		Proximity to a favourable value for the vertical magnetic gradient	PDF , GeoTIF , GRD	
Secondary environment (lake bottom sediments) PDF , GeoTIF , GRD		Proximity to an arsenic anomaly	SHP , PDF , GeoTIF , GRD	
		Proximity to an antimony anomaly	SHP , PDF , GeoTIF , GRD	

Deposits used

A set of 84 deposits consisting of closed mines (2), deposits with a tonnage estimate (2) and worked deposits (80) was compiled for the Baie-James region (Appendix 1). From this set, 13 deposits were randomly extracted to create a control set and set aside for testing purposes (Appendix 1). The rest (71 deposits) formed a weighting set used to measure the spatial association of the parameters. The gold showings were not used for the weighting because adding a relatively undocumented ore body like this to the weighting sets lowers the predictivity (Harris et al., 2005). It should be noted that the major Roberto gold deposit (map A5.1 in Appendix 5), with reserves currently estimated at more than 2 million ounces of gold, is not classified as an orogenic gold deposit but rather as a stratiform replacement gold deposit in a non-carbonatized sedimentary horizon (Ravenelle et al., 2006). It was therefore not used in the modelling, and the present study does not claim to identify deposits of this type. The Roberto deposit is nonetheless encompassed in a high-favourability zone on the final favourability map, suggesting that some of the geological parameters are common to the two deposit types.

Since gold-bearing iron formation deposits are viewed by many geologists in the area as particular examples of orogenic gold deposits, the 18 known gold-bearing iron formation deposits in the study area were added to the 66 orogenic gold deposits in the weighting and control sets. To ensure the validity of this scheme, the response of each type of deposit (iron formation vs orogenic gold) was calculated separately to assess the similarity of their response in terms of contrast values. No significant difference was observed, considering the gaps between the populations of the two groups.

PROCESSING OF PARAMETER MAPS

Lithological control

Reactivity

In some cases, gold precipitation from hydrothermal fluids is caused by a change in physico-chemical conditions during the interaction between these fluids and the host rock (Mikucki, 1998; Hagemann and Cassidy, 2000). For example, sulphidation of Fe-enriched wall rock has been shown to be an effective mechanism in the formation of major deposits in mafic rocks and iron formations (Phillips and Groves, 1983; Hagemann and Cassidy, 2000). This mechanism has been put forward as an explanation primarily in relation to gold deposits that formed in alteration halos around hydrothermal conduits. The reactivity of a given lithology is therefore directly related to its iron content and determines its potential for gold precipitation.

Groves (2002) proposed a diagram for the classification of rocks (Figure 6) based on their reactivity, as determined empirically from their nominal iron content. Using this diagram, a reactivity index was assigned to the Archean lithologies of the Baie-James region. The contrast calculation was performed using WofE analysis. The table in Appendix 2 shows that the lithologies with a reactivity greater than 3 contain more deposits than would normally be expected from a random distribution (this is an inclusive rather than a proximity parameter). Classes 0 to 3 were grouped, and the contrast values were converted into fuzzy values (Vfavor) (Appendix 2 and map A5.2 in Appendix 5).

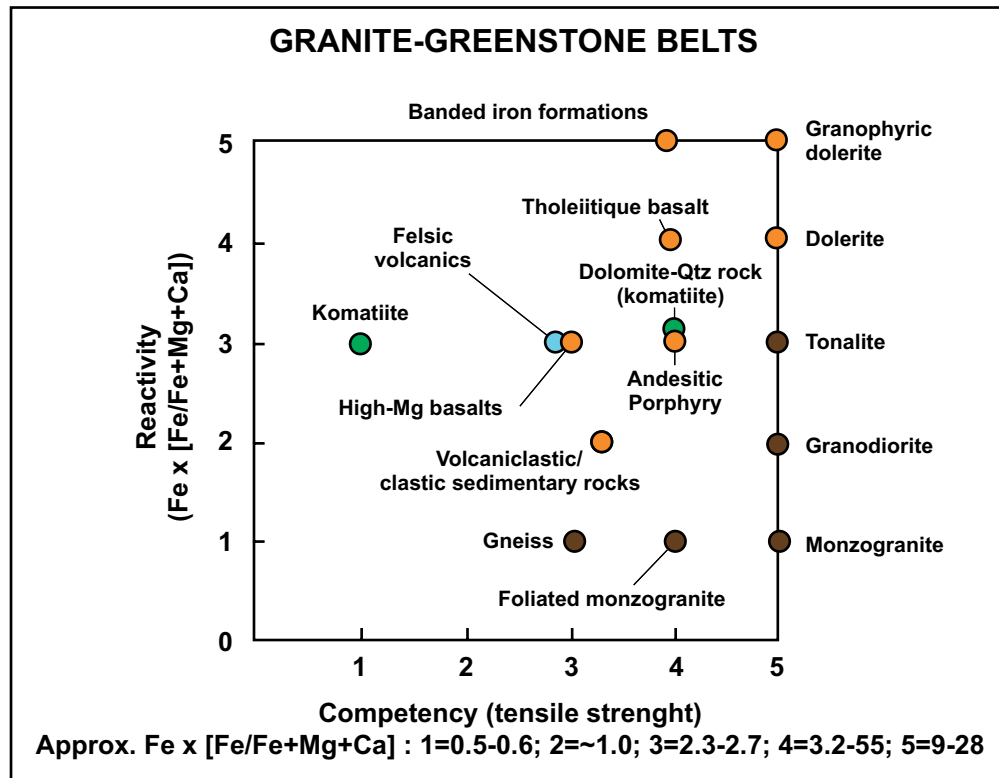


Figure 6 - Reactivity and competency indices of the main lithologies of the Archean greenstone belts (Groves, 2002).

Proximity to felsic to intermediate porphyry dikes

In spite of the very high percentage of deposits that are associated with volcanic or sedimentary rocks, a significant proportion of deposits are hosted in or adjacent to granitoids. For example, in the Abitibi, 25% of the orogenic gold deposits are located in felsic porphyry intrusions, although quartz-feldspar dikes and stocks make up only 4% of the exposed surface. Approximately 75% of the deposits have porphyry intrusions in the surrounding area (Hodgson and Troop, 1988). Felsic to intermediate porphyry intrusions represent favourable structural hosts because they are prone to deformation, favouring fracturing and emplacement of veins.

This parameter is defined by the 441 local observations (in *géofiches*⁵ and drill holes⁶) of felsic to intermediate porphyry dikes. These points were buffered at 200-m intervals, and the contrast values were calculated by the WofE method. Through this step, it was determined that the parameter is predictive up to a distance of 1,800 m and that it can be grouped into 4 distance classes (Appendix 2 and map A5.3 in Appendix 5).

Association with a favourable lithology

Hodgson (1993) and Robert et al. (2005) clearly showed that gold deposits can be found in any type of rock. However, relatively few orogenic gold deposits are found in clastic sedimentary rocks, with the exception of those associated with felsic to intermediate intrusions.

Robert et al. (2005) reported that three rock types contain substantially more gold than would normally be inferred on the basis of their statistical distribution in a greenstone belt:

5- Only *géofiches* whose main lithology ($\geq 50\%$ of the volume of observed lithologies) corresponded to one of the targeted lithologies were retained.

6- The position at depth of favourable lithologies described along the drill hole was projected onto the surface.

- Iron-rich mafic igneous rocks;
- Iron-rich clastic metasedimentary rocks and banded iron formations;
- Porphyry stocks and dikes of dioritic to felsic composition.

In addition, according to Cox et al. (1991), the carbon-rich rocks in which hydrothermal fluids circulate play an important role in the precipitation of gold.

Processing of this parameter involves three steps:

- **Empirical identification of favourable lithologies.** A regional geology grid file is created by converting the cells into polygons on the basis of their lithology. Favourable lithologies are then identified by calculating the contrast values using the WofE method (Table 3). They consist mainly of volcanic rocks, detritic sedimentary assemblages including conglomerate horizons, iron-rich lithologies (peridotite, iron formation) or lithologies with high rheological competency (peridotite, gabbro, basalt, iron formation; see Figure 6). The response of processing is consistent with the findings of Hodgson (1993) and Robert et al. (2005) and it is almost identical with the results obtained for orogenic gold in the Abitibi region (Lamothe and Harris, 2006).
- **Extraction from SIGEOM of *géofiches*, compilation outcrops and drill holes containing the lithologies identified in the previous step.** To calculate the spatial association, point occurrences are used instead of lithology polygons from the geological compilation. There are two reasons for this: 1) the calculated contrast values are higher because the surface area of the distance zones around the points is much smaller than in the case of geologic polygons; and 2) geologic polygons are generalized, but typically incomplete, groupings of various lithological assemblages; the use of point field observations (*géofiches* and drill holes), complemented *compifiches*⁷ in regions mapped prior to 1990 ensures greater reliability with respect to the presence and real position of a given lithology.
- **Extraction from SIGEOM of *géofiches*, compilation outcrops and drill holes containing observations indicating the presence of graphite.** This file is combined with the file created in the previous step.

Following step 3, 13,138 observation or compilation points representing the emplacement of favourable lithologies were buffered at 200-m intervals, and the contrast values were calculated by the WofE method. This parameter is predictive up to a distance of 400 m and was grouped in 3 distance classes (Appendix 2 and see map A5.4 in Appendix 5).

Table 3 - Favorable lithologies for which the probability of spatial association through *WofE* analysis resulted in a contrast value greater than 1.5. Some lithologies may be repeated when grouped into geological units.

Lithology	Contrast
Peridotite	5.43
Iron formation	4.85
Wacke, conglomerate, iron formation	4.27
Wacke, conglomerate	4.17
Andesite and intermediate pyroclastites	3.82
Basalt, gabbro	3.56
Felsic volcanite	3.52
Basalt, andesite	3.32
Basalt, gabbro, amphibolite, andesite	3.23
Intermediate pyroclastite	3.13
Rhyolite, rhyodacite	2.97
Felsic pyroclastite	2.77
Amphibolite (metabasalt)	2.40
Sandstone, iron formation	1.93
Gabbro	1.92

⁷- *Compifiches* are digital compilation outcrops obtained from existing geologic maps.

Lithological diversity

Some researchers have shown that there is a direct relationship between the geological complexity of a sector and the diversity of mineral occurrences found there, especially with respect to potential for gold deposits (Mihalasky and Bonham-Carter, 2001; Hagemann and Cassidy, 2000). The concept of lithological diversity (or lithodiversity), defined as the frequency of rock types per unit area, was also used by Brown et al. (2003a and b) to assess the potential for orogenic gold deposits in the Kalgoorlie Terrane of Western Australia.

This processing performed on a grid file, obtained by conversion of a lithology shapefile, assigns a number to each cell of the image indicating the number of unique lithologies counted within a window whose size is determined by the modeller. Tests using windows of 5, 25 and 100 km² showed that 25 km² was optimal, given the variable map scales characterizing the polygon file of Baie-James lithology. WofE shows that maximal optimization of the results is obtained by a grouping in 5 classes using Jenks' natural breaks scheme (1967). WofE analysis shows that only 3 classes of cells with a density equal to or greater than 7 unique lithologies per 25 km² exhibit a significant contrast value (Appendix 2 and see map A5.5 in Appendix 5).

Structural control

Orogenic gold deposits are emplaced along active convergent margins during compressive tectonic regimes (Groves et al., 1998). This type of setting promotes the flow of hydrothermal fluids along major shear zones, which serve as structural traps for gold that precipitates out of solution. The importance of these structures is very obvious in the Abitibi region, where 87% of mines are located within 5 km of the Cadillac and Porcupine-Destor faults. In the Baie-James region, structures equivalent to these two faults have not been identified.

Proximity to a local fault or shear zone

This parameter uses the local observations in planar structures of *géofiches* and descriptions of drill holes that correspond to evidence of shearing and faulting. Following analysis, 1,880 points were extracted and were buffered at 200-m intervals. Based on WofE assessment, these intervals were grouped in 4 distance classes of 200, 400, 1400 and >1400 metre intervals (Appendix 2 and see map A5.6 in Appendix 5).

Proximity to a mapped Archean fault

The processing was performed on a shapefile of Baie-James faults from which Proterozoic faults lacking clear-cut geophysical features and preferentially oriented between N300° and N070° were manually removed. WofE optimization resulted in distance classes of 200, 800 and > 800 metre intervals (Appendix 2 and see map A5.7 in Appendix 5).

Density of mapped Archean faults

Fault density (number of faults per unit area) is an indicator of regional deformation in a fragile regime. A high fault density is conducive to hydrothermal circulation and the formation of structural traps for gold precipitation (Hagemann and Cassidy, 2000).

A number of studies suggest that second- and third-order structures within the regional fracture network are preferential deposition sites, whereas relatively few deposits are located in the core of the main conduits (Eisenlohr et al., 1989; Groves et al., 1989; Robert, 1990). Although it is theoretically possible to use spatial analysis to assess the relative hierarchy of faults, this approach cannot be applied to the entire Baie-James region because of variability in the level of detail of the maps available for the study area. Nonetheless, the concept of density is applicable and provides a means of targeting sectors in the region that are most likely to contain deposits.

Using the file of mapped Archean faults created in the previous step, a grid image of fault density per square kilometre was generated by using a 4-km-by-4-km window. The values were grouped in 10 classes by the natural breaks method. WofE optimization allowed these density values to be grouped in 3 classes (See map A5.8 in Appendix 5).

Proximity to a local fold hinge

This parameter is generated by assessing the *géofiches* featuring planar structures that describe fold hinges⁸. After the resulting 285 points were buffered at 200-m intervals and optimized by WofE analysis, giving distance classes of 200, 600, 2,800 and > 2,800 metre intervals (Appendix 2 and see map A5.9 in Appendix 5).

Proximity to quartz veins

Quartz vein deposits are the most common type of gold deposit in the Baie-James region (Robert, 1990). This spatial association was evaluated by extracting all of the point occurrences (2,325 points) of quartz veins from the databases of compilation outcrops, *géofiches*, whole-rock analyses and drill holes⁹. The contrast values remain significant up to a distance of 800 m, becoming irregular beyond that (Appendix 2 and see map A5.10 in Appendix 5).

Evidence of hydrothermal activity in the bedrock

Analyses of metal indicators

Orogenic gold deposits are typically enriched with a certain number of metallic elements (Hagemann and Cassidy, 2000). The following elements were tested and validated as indicators of the presence of gold deposits in the Baie-James region: Au, Ag, As, Sb, B and Mo¹⁰. Each processing step described below is aimed at assessing the spatial association between the presence of an anomalous level of each of these elements and proximity to a gold occurrence. Processing was performed using a database of 10,333 samples from MNRF studies and statutory work.

Proximity to an Au anomaly

All of the Au analyses from drill holes and rock samples were extracted from SIGEOM. The data from drill holes were projected onto the surface and the grades were converted into ppb. The data for Au in the rock samples were extracted for all the analytical methods. The anomaly threshold for Au contents was set at 50 ppb using a quantile-quantile (QQ) plot (Figure 7). The 2,222 occurrences with contents higher than or equal to this value (out of 5838 analyses) were buffered by 200-m intervals. Following WofE optimization, the distance classes were grouped in intervals of 200, 400, 1,200 and > 1,200 metres (Appendix 2).

This parameter should have been the most predictive of all (antimony achieved the highest contrast value). The large number of gold anomaly analyses not associated with the deposits in the weighting set slightly diluted the favourability of the parameter (See map A5.11 in Appendix 5).

Proximity to an Ag anomaly

Based on the QQ plot (Figure 7), the anomaly threshold for Ag contents was set at 3 ppm (326 anomalous samples out of 3,595 analyses). After WofE optimization, the distance classes were grouped in intervals of 400, 2,000, 3,200 and > 3,200 metres (Appendix 2). Silver shows a favourable spatial association at a greater distance from gold deposits than is the case for gold (See map A5.12 in Appendix 5).

8- A test carried out on the axial traces derived from geological maps and from interpretations of Landsat images and geophysical patterns showed an absence of spatial association with gold deposits.

9- Data from drill holes were projected onto the surface

10- Although sulphur was used in the modelling for the Abitibi, it was not used here because not enough analyses were available.

Proximity to an As anomaly

A large number of orogenic gold deposits in the area exhibit arsenopyrite mineralization¹¹ (Gauthier and Laroque, 1998; Gauthier et al., 1997; Chartrand and Gauthier, 1995). WofE assessment of the spatial association between arsenic contents and gold deposits confirmed that this element is an effective indicator of proximity (Figure 7). The anomaly threshold for As was estimated to be 8 ppm (Figure 7; 1,113 anomalous samples out of 3,417 analyses), and distance classes of 200, 1,200 and > 1,200 m were determined through WofE optimization (Appendix 2 and see map A5.13 in Appendix 5)

Proximity to an Sb anomaly

Orogenic gold deposits sometimes have substantial Sb contents, generally consisting of stibine locally associated with gold, notably at Red Lake (Dubé et al., 2002). The anomaly threshold for antimony was set at 15 ppm (Figure 7) (135 anomalous samples out of 2,160 samples analysed). Following WofE optimization, the distance classes were grouped in intervals of 200, 800, 2,400, 3,000 and > 3,000 metres (Appendix 2) (See map A5-14).

Of all the parameters examined, an antimony anomaly was found to be the best indicator of proximity to a gold deposit, with a maximum contrast value of 8.7243 (Appendix 2). A conversion equation was applied to scale the contrast values of the parameters between their minimum and maximum values (re: “Methodology” section), and the maximum contrast value was assigned a fuzzy value of 1. This highly positive response of the parameter is essentially due to the small number of antimony analyses present in the database. The proximity of these analyses to known gold deposits and the relatively limited surface area of predictive distance zones explain this high contrast value.

Proximity to a B anomaly

In the two main volcanic belts of the Baie-James region, there are many orogenic gold deposits that show tourmalinization of the wall rocks of quartz $\pm$ carbonate veins (Gauthier and Laroque, 1998; Gauthier et al., 1997) characterized by anomalous boron levels. The anomaly threshold for antimony was set at 75 ppm (192 anomalous samples out of 642 analyses) using a QQ plot (Figure 7), and distance classes of 200, 600, 3,000 and > 3,000 metre intervals were created using WofE optimization (Appendix 2). This parameter shows an excellent response as an indicator of proximity (rank 4) (See map A5.15 in Appendix 5).

Proximity to an Mo anomaly

Although molybdenum is usually not considered an indicator of the presence of orogenic gold deposits, this element shows a positive spatial association with the gold deposits in the Baie-James region (Appendix 2). The anomaly threshold was set at 22 ppm (228 anomalous samples out of 3,299 analysed) using a QQ plot (Figure 7), and WofE optimization was performed, resulting in distance classes of 200, 1,400, 3,200 and > 3,200 metre intervals (Appendix 2 see map A5.16 in Appendix 5).

¹¹ - Certain non-gold deposits can, however, exhibit high arsenic contents, notably in the lower and Middle Eastmain region (Gauthier et Laroque, 1998).

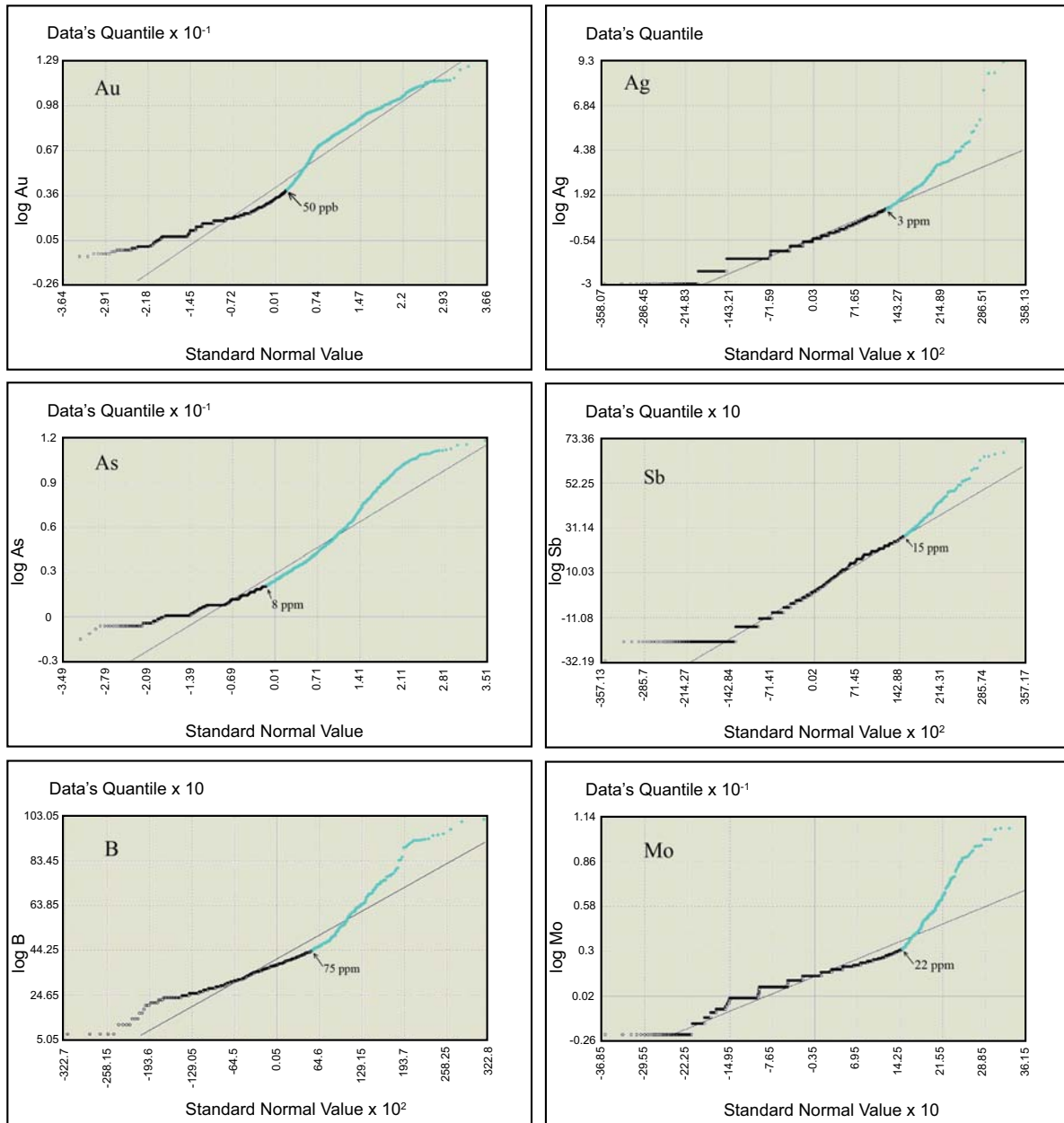


Figure 7 - Quantile-quantile plots showing the anomaly thresholds of metallic elements used as indicators of proximity to orogenic gold deposits.

Lithochemical alteration indices

Lithochemical alteration indices can be used to locate zones in which hydrothermal fluids flowed and were discharged, leading to the formation of gold deposits (Franklin, 1997). Processing is performed using a lithochemical database of 5,699 samples of igneous rocks for which the oxide contents were analysed. All the altered samples exceeding the anomaly threshold¹² of one of the four following indices were grouped in a single file of altered samples for which the spatial association was calculated by the WofE method. This approach obviates the need to use several different files for points corresponding to more than one index, which could lead to artificial overweighting during the final combination of parameters.

¹²- Calculated by the natural break method in a QQ plot.

Peraluminosity index

This index measures the aluminum enrichment of rock altered as a result of the loss of sodium or calcium (Mathieson and Hodgson, 1984). The equation for this index is:

$$\text{Molar percentage Al}_2\text{O}_3 / (\text{Na}_2\text{O} + \text{CaO} + \text{K}_2\text{O})$$

The anomaly threshold was estimated at 1.5 (Figure 8). Some 254 altered samples were extracted.

Chlorite index

The index measures the chloritization of rock by the addition of Mg and Fe (Saeki and Date, 1980). The equation for the index is: $(\text{MgO} + \text{Fe}_2\text{O}_3) / (\text{MgO} + \text{Fe}_2\text{O}_3 + 2\text{CaO} + 2\text{Na}_2\text{O})$

The anomaly threshold was estimated at 0.54 (Figure 8). There are 776 samples with values higher than this.

Hashimoto index

This index measures the chloritization and/or sericitization of rock through the addition of Mg and K (Ishikawa et al., 1976). The equation for the index is: $(\text{MgO} + \text{K}_2\text{O}) / (\text{MgO} + \text{K}_2\text{O} + \text{CaO} + \text{Na}_2\text{O})$

The anomaly threshold was estimated at 0.58 (Figure 8). There were 784 samples with a value higher than the threshold.

Alkali index

The index measures the loss of CaO and Na₂O during the alteration of feldspath (Saeki and Date, 1980). The equation for this index is: $(\text{Na}_2\text{O} + \text{CaO} / (\text{Na}_2\text{O} + \text{CaO} + \text{K}_2\text{O}))$

The anomaly threshold was estimated at 0.95 (Figure 8). There were 1,348 samples with a value higher than the threshold.

Altered samples were grouped in a single file, and distance classes of 200, 600, 3,000 and > 3,000 metre intervals were created through WofE optimization (Appendix 2 and see map A5.17 in Appendix 5).

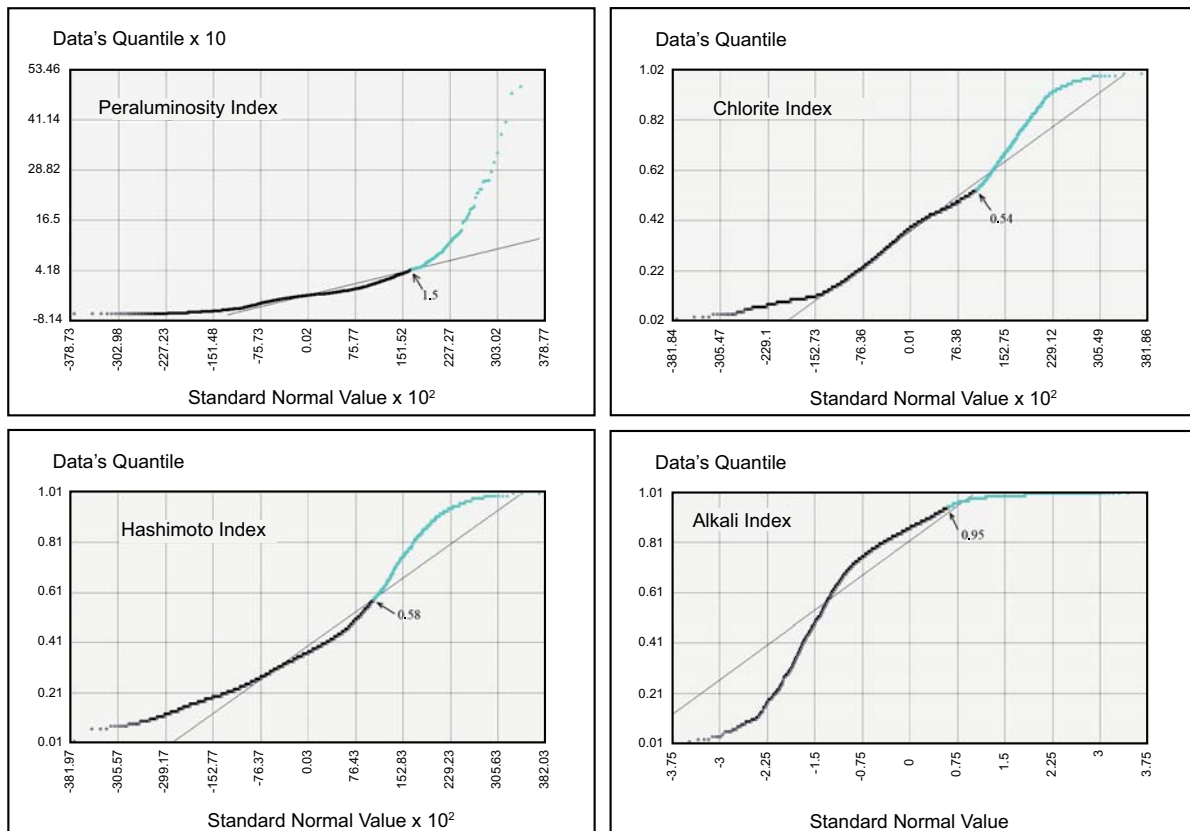


Figure 8 - Determination of the anomaly threshold of lithochemical alteration indices using normalized quantile-quantile plots.

Proximity to an anomalous ISER index

Alteration phenomena can be identified through the use of certain normative mineral indices calculated with the NORMAT programs (Piché and Jébrak, 2004). These indices can be used to quantify the alteration regardless of the original composition of the rocks. The ISER index is used to target potassium alteration zones.

The anomaly threshold of the ISER index was estimated at 37% using a normalized QQ plot (Figure 9). Values higher than this threshold correspond to lithologies with anomalous sericite alteration, which are typically found on the margins of alteration zones. WofE optimization led to the establishment of distance classes of 1,000, 2,000, 5,000 and > 5,000 metre intervals (Appendix 2 and see map A5.18 in Appendix 5).

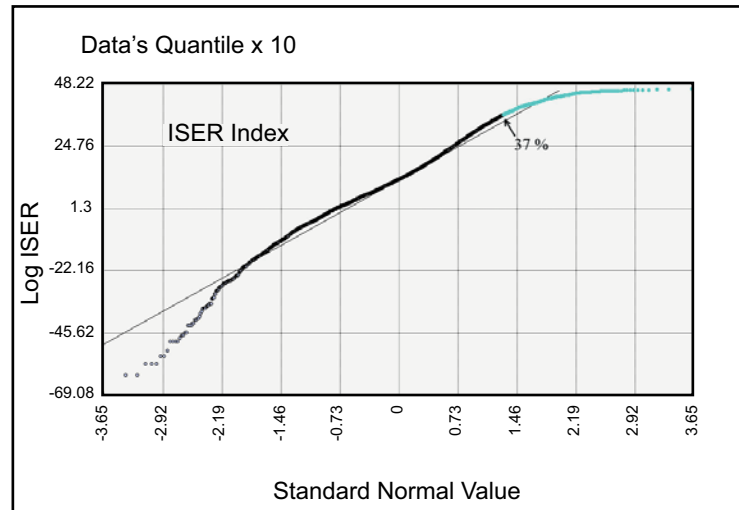


Figure 9 - Determination of the anomaly threshold of the ISER index.

Proximity to a mineral indicator of alteration or mineralization

Gold deposits generally exhibit extensive lateral alteration zones whose mineral phases comprise proximal to distal assemblages. The fluids involved in the formation of orogenic gold deposits are typically in equilibrium with the dominant host rock, forming at the ambient pressures and temperatures characterizing metamorphism. The hydrothermal halos surrounding the deposits are therefore quite cryptic and poorly developed (Boyle, 1961; Goldfarb et al., 1986; Clark et al., 1989). The size of these halos around mineralized veins can range from a few centimetres to several kilometres (Colvine, 1989; Eilu et al., 1998).

Proximity to a mineral indicator of alteration

Greenschist facies alteration minerals consist mainly of various carbonate phases (chiefly ankerite and/or dolomite) and alkaline metasomatic minerals such as sericite, muscovite, biotite, albite and/or chlorite, and tourmaline. In ultramafic rocks, talc and fuchsite are predominant instead of muscovite, and the main carbonates are siderite and magnesite. The presence of quartz veins and silicification appears to be related more to remobilization processes than to the inflow of hydrothermal fluids (Goldfarb et al., 2005). These phenomena, which are reliable indicators of proximity, are used in the model.

In amphibolite facies, the alteration halos are generally narrower, and may not extend beyond 10 metres (Eilu et al., 1998). Amphibole, garnet and diopside are common alteration silicates, and calcite is the stable carbonatized phase. Ca-plagioclase and potassium feldspar are locally observed in the lower amphibolite facies alteration assemblage, since albite is no longer stable. Although biotite is the alteration mica proximal to the lower amphibolite facies, it is generally observed only in the distal portion of the upper amphibolite facies halo (Goldfarb et al., 2005).

Point observations for these minerals were extracted from the drill holes (position projected onto the surface), compilation outcrops and SIGEOM *géofiches* to create a vector file of relevant deposits (7,350 occurrences extracted). Distance classes of 200, 400 and > 400 metres were created through WofE optimization (Appendix 2 and see map A5.19 in Appendix 5).

Proximity to pyrite, arsenopyrite or pyrrhotite mineralization

The quantity of sulphides rarely exceeds 3% to 5% of the composition of veins or altered wall rock (Goldfarb et al., 2005). However, it is possible to find massive sulphide lenses and, in exceptional cases, the iron-bearing silicates of certain iron formations may be completely replaced by sulphides (e.g., Lupin; Bullis et al., 1994).

In greenschist facies, sulphide minerals consist mainly of pyrite, pyrrhotite or arsenopyrite. Arsenopyrite is predominant in deposits located in metasediments, whereas pyrite is usually the sulphide mineral in deposits in volcanic rocks and granitoids. However, at temperatures higher than 400°C, loellingite and pyrrhotite may be predominant instead of arsenopyrite or pyrite, particularly in reducing hydrothermal systems. Base metals are present in trace amounts and may present a non-economic anomaly signature (Kerrick and Hodder, 1982).

Point observations for these 3 minerals were extracted from drill holes (projected onto the surface), compilation outcrops and SIGEOM *géofiches* to create a shapefile of relevant deposits (3,729 occurrences extracted). Distance classes of 200, 400 and > 400 metres were created using WofE optimization (Appendix 2 and see map A5.20 in Appendix 5).

Geophysical signature

Digital data for the total residual magnetic field and the vertical magnetic gradient reveal certain lithological properties that may be relevant for the present study. As mentioned in section “Reactivity”, the reactivity of rocks that are likely to cause the precipitation of gold contained in hydrothermal solutions is directly related to their Fe content. In most cases, the Fe content also has a proportional influence on the magnetic signature of the rock. This processing step is aimed at determining whether there is a natural relationship between the intensity of the magnetic signature of surrounding lithologies and the presence of gold-bearing deposits. Geophysical data—like data from the secondary environment—provide uniform coverage of the study area, helping to compensate to some extent for the absence of suitable geological mapping in a few sectors.

Favourability associated with the total residual magnetic field

Digital data for the total residual magnetic field obtained from the federal survey (200-m pixel resolution) were used to process this parameter. The values were reclassified by $\frac{1}{4}$ of a standard deviation into 26 classes and analysed using the WofE approach. An initial examination revealed that magnetic classes greater than 689 nanoteslas have a higher probability of association with gold deposits; these classes generally correspond to iron formation units and tholeiitic basalt units, as well as to certain intrusions and ultramafic volcanic rocks. Visual inspection revealed that deposits tend instead to be located along the margin of these zones. This parameter is therefore processed using WofE analysis of the favourability of distance zones around residual magnetism values greater than 689 nanoteslas. Four zones were defined (1,000, 3,000, 6,000 and > 6,000 metres) using WofE optimization (Appendix 2 and see map A5.21 in Appendix 5).

Favourability associated with the vertical magnetic gradient

Processing for this parameter is similar to that for the total residual magnetic field. WofE analysis of the spatial association shows that zones with gradient values higher than 0.344 nT/m are preferentially associated with gold deposits. Two distance classes of 400 and 800 metres around these zones show a favourable association (Appendix 2 and see map A5.22 in Appendix 5).

Evidence of mineralization in the secondary environment

Almost full coverage of the Baie-James region is available thanks to various lake bottom sampling surveys. Surveys were carried out by the SDBJ in the 1970s and by the MRNF in 1997. Appendix 4 provides a more detailed description of the surveys and the location of the sampling sites.

Of the lithochemical element indicators listed in section “Analysis of metal indicators”, only arsenic and antimony in secondary environment analyses show a conclusive association with gold deposits. The other elements are either absent from the database or their distribution is too erratic to allow them to serve as an indicator.

Proximity to an arsenic anomaly

A normalized arsenic database developed by Marc Beaumier was used for this processing (Appendix 4). Four separate files composed of samples whose lowest arsenic contents corresponded to the 95th, 97.5th, 98th and 99th percentiles of the total population (Figure 10) were created and analysed by the WofE method. The entire 99th percentile was found to be the best indicator with the highest contrast value, and the points were buffered at 400, 2,000 and > 2,000 metre intervals following WofE optimization (Appendix 2 and see map A5.23 in Appendix 5).

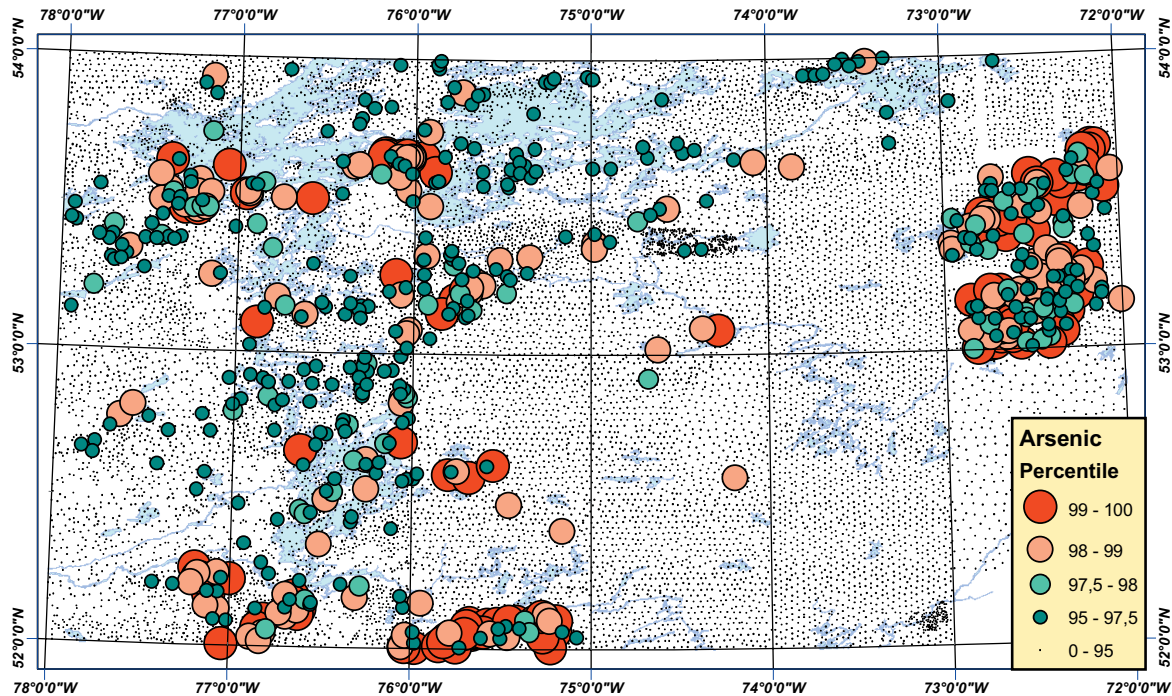


Figure 10 - Distribution of samples for which the lowest arsenic levels in lake bottom sediments corresponded to the 95th, 97.5th, 98th and 99th percentiles of the total population.

Proximity to an antimony anomaly

The antimony levels were derived from neutron activation re-analyses of most of the samples collected by the SDBJ and do not need to be normalized. The same method as was applied to arsenic was used (Figure 11), and samples for which the lowest levels corresponded to the 98th percentile of the population were subjected to WofE analysis, being considered the best indicators with the highest contrast value. The points were buffered by 800, 2,000 and > 2,000 metre intervals following WofE optimization (Appendix 2 and see map A5.24 in Appendix 5).

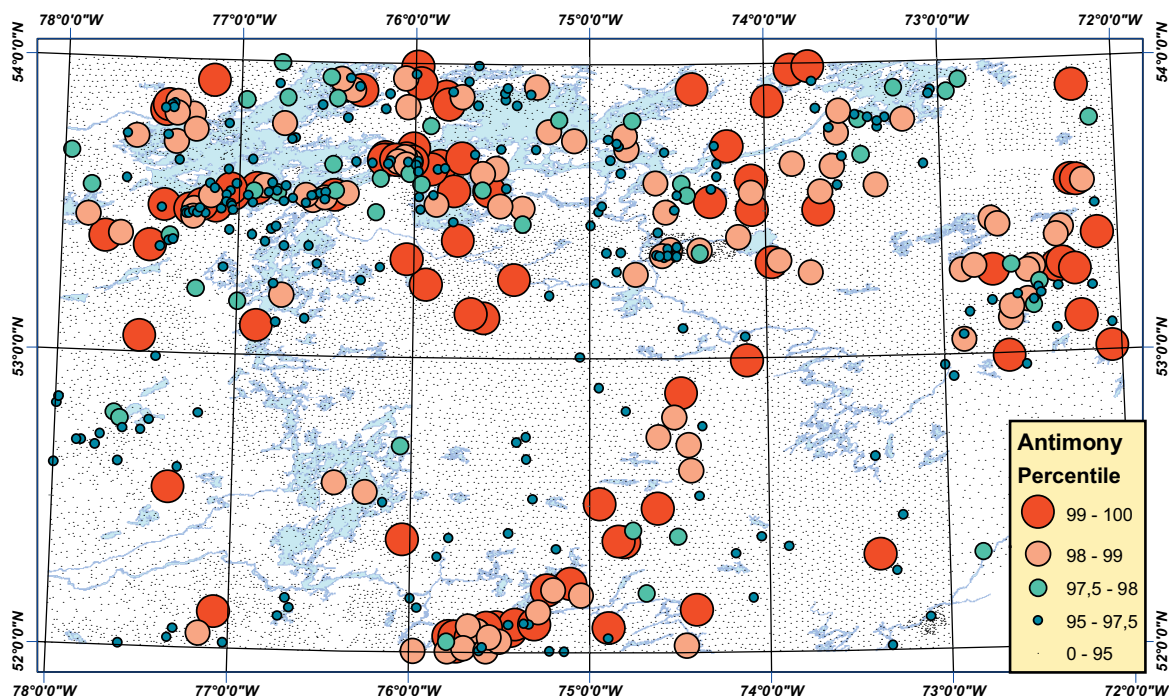


Figure 11 - Distribution of samples for which the lowest antimony levels in lake bottom sediments corresponded to the 95th, 97.5th, 98th and 99th percentiles of the total population.

OVERALL FAVOURABILITY FOR OROGENIC GOLD MINERALIZATION IN THE BAIE-JAMES REGION

Creation of the favourability map for orogenic gold mineralization in the Baie-James region

To generate the final favourability map¹³ for orogenic gold deposits, the various favourability maps created in the section “Processing of parameters maps” were combined using a fuzzy logic method (re: section “Methodology”) based on the inference model presented in Appendix 3. The different factors of the FUZZYGAMMA operators (shown in parentheses in the figure in Appendix 3) were calibrated taking into account the predictivity of the combined parameters, for which the main constraint is the requirement that the final map have a background value of about 0.5. This method avoids overweighting of parameters (a drawback often encountered when fuzzy logic is used as a combination method), while adhering to the principle of non-association, either favourable or unfavourable, of extensive sectors of the region for which the level of knowledge is low (levels in dark blue in Figure 12). The background value of the favourability map is 0.493 and the maximum value recorded for all the cells is 0.872 (Appendix 2 and see map A5.25 in Appendix 5).

13- The map can be downloaded in SHP, PDF, GeoTIF or GRD format from Table 2.

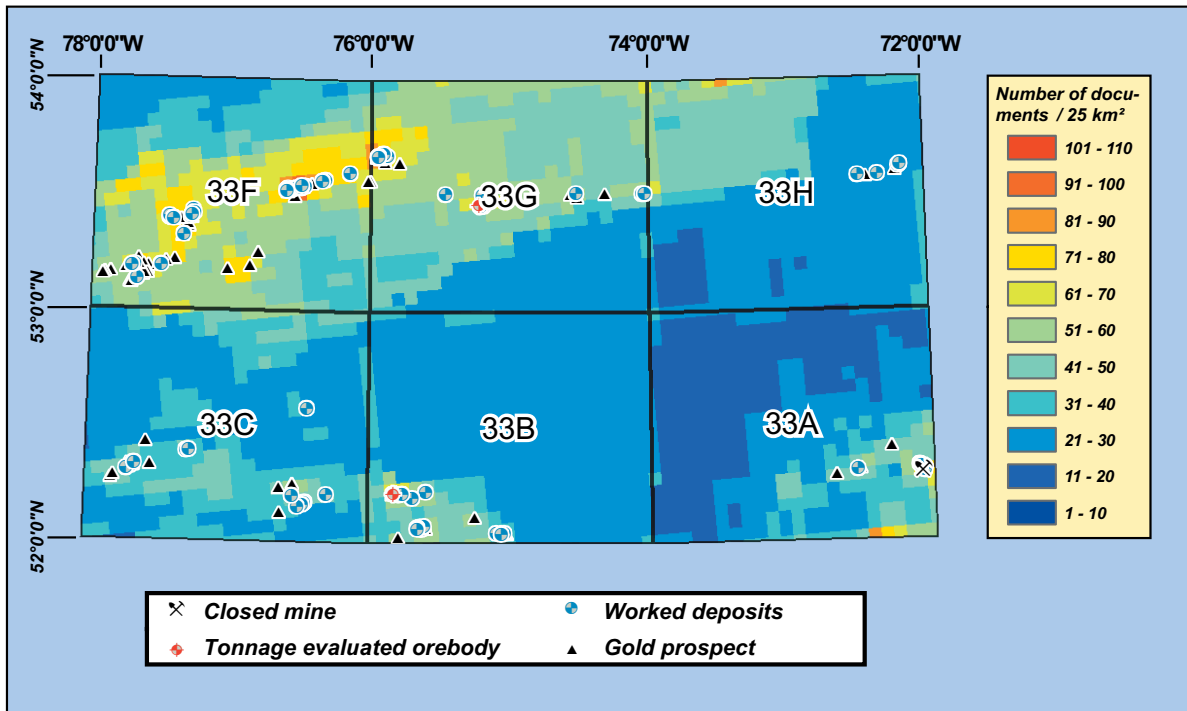


Figure 12 - This figure illustrates the level of knowledge of Baie-James geology by representing the density of documents, per 25 km² of surface area, extracted from the EXAMINE database. The documents come from MRNF sources or from mineral exploration companies. The zones with a relatively high level of exploration (in orange) are richer sources of geological information for the model than zones with little exploration (in blue). In the latter case, few useful elements are extracted from SIGEOM and the reliability of the results is reduced. The real gold potential of these regions may be underevaluated.

Determination of high-favourability zones and targets

Analysis of favourability for orogenic gold deposits in the Baie-James region allows us to achieve two objectives: 1) to define, for the Baie-James, high-favourability zones (HFZ) for gold deposits that will help to focus mineral exploration; and 2) to define and document a certain number of targets consisting of portions of HFZ that were not yet staked at the time of the study.

In order to define high-favourability zones, a minimal favourability threshold value must be determined beyond which the favourability of a zone acquires significant predictivity for the presence of orogenic gold occurrences. To define this threshold, overall favourability values associated with the 84 mines, deposits with an estimated tonnage and worked deposits in the Baie-James region were plotted on a normal probability diagram (Figure 13). Two different normal populations were identified. The largest population consists of 82 (97.6%) of the 84 orogenic gold deposits (excluding showings) and is situated above the minimal threshold value of 0.669. The two ore bodies whose values are below the threshold form a second, distinct population which the favourability map does not target well, because the available data are insufficient or contradictory.

Using the minimum threshold value, a set of cells whose values are equal to or greater than 0.669 can be delineated based on the final favourability map, and the groups of cells can be converted into polygons. These polygons constitute [high-favourability zones](#) (Figure 14).

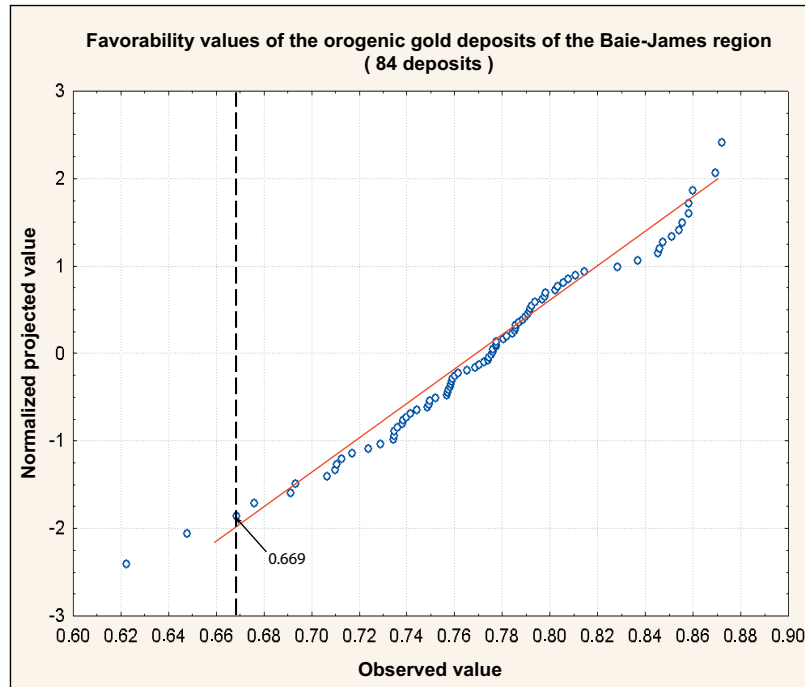


Figure 13 - Determination of the high-favourability threshold using a normal probability diagram. The observed values (X-axis) correspond to the favourability values measured for each of the 84 orogenic gold deposits on the final favourability map. Showings are excluded from this step, since they were not used in processing. This type of plot can be used to distinguish between the different populations in a set. Encompassing 97.6% of the set of orogenic gold deposits in the Baie-James region, the points that fall on the straight line form a homogeneous population which meets the model criteria because it follows a Gaussian distribution of the measured favourability values. The two deposits that are below the high-favourability threshold (0.68975) are Eastmain-3 (33C06) and PG-Vein-Zone C (33F04).

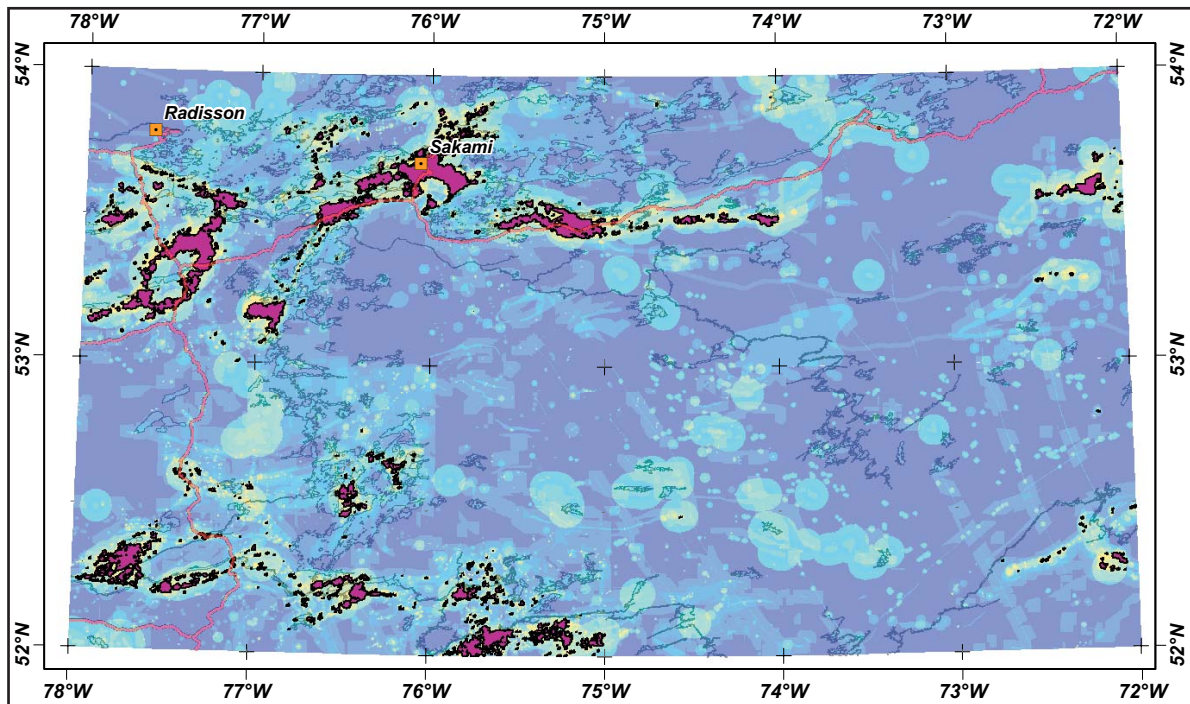


Figure 14 - Location of high-favourability zones (in purple) for orogenic gold deposits in the Baie-James. For more details, see the accompanying maps (500K, 250K and 50K).

The [final version of the target areas](#) was created with the help of an active or pending mining titles shapefile for the Baie-James area updated on February 6, 2008. Portions of the HFZ polygons unstaked were then grouped into 114 targets with high gold potential. These are displayed on the various-scale maps joined to this document which can be easily downloaded from Appendix 3. A target database is linked to each target label and may be activated by a single click on it.

Validation of results

Figures 15a and 15b contain two comparative plots illustrating the predictivity of the favourability map as a function of three sets of orogenic gold occurrences in the Baie-James, namely: 1) a weighted set of 71 mines, deposits with a tonnage estimate and worked deposits used to create the favourability map; 2) a control set of 13 deposits that were not used in processing; and 3) a set of 79 showings which were likewise not used for processing. The graphs show the cumulative percentage of ore bodies (y-axis) relative to the percentage of area corresponding to the favourability values sorted in descending order (x-axis). It can be seen in Figure 15b that 88% of the deposits in the weighting set are predicted with only 1% of the area showing high favourability, a result that is very comparable with that obtained for the control set (92%). The favourability map therefore shows a high predictive capacity and excellent reliability.

In comparison, only 60% of the showings are predicted for the same cumulative favourability surface area (Figure 15b). This discrepancy likely results from the fact that the deposits used in the weighting process (mines, deposits with an estimated tonnage or worked deposits) are generally characterized by an abundance of spatial data, including a certain number of drill holes and rock analyses. The high volume of data aid in accurately defining their geological attributes as well as their potential association with a given parameter. Conversely, the showings have been studied to a lesser extent and their immediate environment is generally poorly characterized. The gaps in knowledge affect a certain number of parameters (missing drill-hole observations, limited sampling, deficient classification, etc.), limiting the possibility of generating a higher level of local favourability.

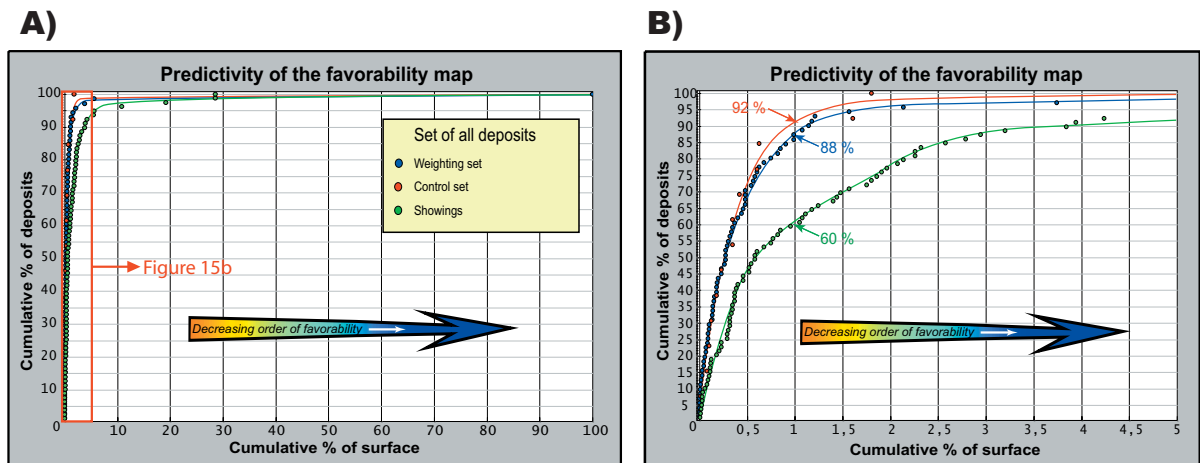


Figure 15a - Plot illustrating the predictivity of the mineral potential map generated by hybrid fuzzy logic. On the x-axis, the cumulative surface (in percentage) of the cells ranked in decreasing order of favourability is shown, and on the y-axis the cumulative percentage of deposits targeted by these cells is shown.

Figure 15b - Enlarged portion of plot 15a. About 88% of the 71 orogenic gold deposits used for the processing (weighting set, in blue) are located in the most favourable group of cells equivalent to 1% of the surface area of the map. For the same favourable surface area, 92% of a control set of 13 deposits (not used for the processing, in red) and 60% of showings (also not used for the processing, in green) in the study area are targeted.

CONCLUSION

A hybrid fuzzy logic approach has been used to produce a favourability map for orogenic gold deposits which is characterized by excellent predictivity and reliability. This methodology is not new, since at least two studies using this approach have been published (Porwal et al., 2003b; Lamothe et al., 2005). The favourability studies carried out at the MRNF (Lamothe and Harris, 2006; Lamothe et al., 2005) nonetheless diverge from the majority of mineral potential assessment studies in two key aspects: 1) the definition of high-favourability zones through the objective determination of a minimal favourability threshold; and 2) the definition of targets, consisting of the portions of the high-favourability zones that were unstaked at the time of the study. The concept of a target is temporary since the situation may change with the issuance of mining titles. It has nonetheless proven to be an effective tool for promoting mineral exploration, as evidenced by the response of mining industry stakeholders every time a new mineral potential study is published. Since November 2007, which is when mineral potential and HFZ maps first began to be made available on GESTIM (MRNF's web-based mining title management system), the concept of target has become less relevant, although it remains a useful tool.

Although the parameters chosen for this study apply specifically to the orogenic gold model, it should be noted that the sizeable Roberto gold deposit (Eleonore project, NTS 33C/09), currently classified as a stratiform replacement gold deposit in sedimentary rock, is located in a high-favourability zone. Two conclusions are possible: 1) this type of deposit has enough parameters identical with the orogenic gold model that it is targeted by the processing approach used here; and/or 2) the Roberto deposit is an orogenic gold deposit.

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APPENDIX 1 - LIST OF 84 OROGENIC GOLD DEPOSITS USED TO CALCULATE THE WEIGHTINGS AND VALIDATE THE OROGENIC GOLD POTENTIAL MAP

NTS SHEET	ZONE NAME	DEPOSIT NAME	DEPOSIT STATUS	UTM	COORDINATES		TYPE	Vfavor(m)
					E	N		
33A08	Zone A	Eastmain	Closed mine	18	698788	5798524	Orogenic gold	0.709
33A08	Zone B	Eastmain	Closed mine	18	699161	5798114	Orogenic gold	0.700
33B04	Zone Eau Claire	Zone Eau Claire	Tonnage-estimated orebody	18	444365	5785466	Orogenic gold	0.752
33G06	Orfée	Orfé	Tonnage-estimated orebody	18	485613	5923702	Gold-bearing iron formation	0.758
33A07	Exko Showing	Exko Showing	worked deposit	18	667680	5798105	Orogenic gold	0.680
33A08	Centraux (Lac Julien-SE)	Centraux (Lac Julien-SE)	worked deposit	18	697930	5799680	Orogenic gold	0.709
33A08	Lac Julien	Lac Julien	worked deposit	18	697180	5800330	Orogenic gold	0.690
33A08	Zone C	Eastmain	worked deposit	18	699817	5797538	Orogenic gold	0.634
33B03	Rock'n Hammer	Rock'n Hammer	worked deposit	18	497682	5766510	Gold-bearing iron formation	0.716
33B03	Ti Beu	Ti Beu	worked deposit	18	496237	5766241	Gold-bearing iron formation	0.762
33B03	Frank	Frank	worked deposit	18	493922	5766627	Gold-bearing iron formation	0.767
33B04	C87-L06/MB-95-06	Zone Eau Claire	worked deposit	18	445128	5785165	Orogenic gold	0.748
33B04	Tranchée 8+50W	Zone Eau Claire	worked deposit	18	444039	5785420	Orogenic gold	0.735
33B04	LA/Dome C	LA-Fisher	worked deposit	18	457732	5768596	Orogenic gold	0.768
33B04	Fisher	LA-Fisher	worked deposit	18	457584	5768484	Orogenic gold	0.768
33B04	Faillie Cannard	Ours	worked deposit	18	446977	5785012	Orogenic gold	0.747
33B04	Ours	Ours	worked deposit	18	446844	5785131	Orogenic gold	0.735
33B04	PP-51 Est	PP-51 Est	worked deposit	18	458998	5769891	Orogenic gold	0.779
33B04	L15	L15	worked deposit	18	455870	5769144	Orogenic gold	0.784
33B04	Orignal	Orignal	worked deposit	18	448405	5785455	Orogenic gold	0.684
33B04	Dome A	Dome A	worked deposit	18	455649	5768709	Orogenic gold	0.790
33B04	Natel	Natel	worked deposit	18	453350	5783427	Orogenic gold	0.654
33B04	Serendipity	Serendipity	worked deposit	18	459918	5786491	Orogenic gold	0.663
33B04	Indice K	Indice K	worked deposit	18	457233	5769663	Orogenic gold	0.787
33B04	PP-51 Ouest	PP-51 Ouest	worked deposit	18	457943	5769432	Orogenic gold	0.753
33C01	Zone Chino	Zone Chino	worked deposit	18	401345	5781308	Orogenic gold	0.747
33C01	Lac Renard	Lac Renard	worked deposit	18	397900	5779650	Orogenic gold	0.665
33C01	Zone Contact	Zone Contact	worked deposit	18	400277	5780669	Orogenic gold	0.749
33C01	Zone Chino Est	Zone Chino	worked deposit	18	401800	5781650	Orogenic gold	0.715
33C01	Black Dog Lake (Lac Hudson)	Black Dog Lake (Lac Hudson)	worked deposit	18	411878	5785183	Gold-bearing iron formation	0.680
33C02	Chabela 2314	Chabela 2314	worked deposit	18	395447	5785007	Orogenic gold	0.664
33C05	Lac Elmer-Zone Gold	Lac Elmer-Zone Gold	worked deposit	18	319776	5801300	Orogenic gold	0.710
33C05	Zone Gabbro	Zone Gabbro	worked deposit	18	318236	5799636	Orogenic gold	0.760
33C05	Barrick	Barrick	worked deposit	18	315992	5798536	Orogenic gold	0.725
33C06	Grid-711-R	Grid-711-R	worked deposit	18	346131	5807269	Orogenic gold	0.702
33C06	Eastmain-3	Eastmain-3	worked deposit	18	344975	5807235	Orogenic gold	0.617
33C09	Anomalie 42 (Sdbj)	Anomalie 42 (Sdbj)	worked deposit	18	402927	5826755	Orogenic gold	0.776
33F03	Lac Kaychikua-pichu-Ouest (Secteur D)	Lac Kaychikuapi-chu-Ouest (Secteur D)	worked deposit	18	333130	5896306	Orogenic gold	0.771
33F04	Zone n° 12	Zone n° 12	worked deposit	18	319111	5896071	Orogenic gold	0.747
33F04	Zone n° 5	Zone n° 5	worked deposit	18	320295	5896601	Orogenic gold	0.717
33F04	PG Vein-Zone C	PG Vein-Zone C	worked deposit	18	321284	5889803	Orogenic gold	0.629
33F06	PG-30	PG-30	worked deposit	18	339037	5918316	Orogenic gold	0.707

The 13 deposits highlighted in yellow were used to validate the results. The deposits are located on map A5.1 provided in Appendix 5.

APPENDIX 1 (continued)

INTS SHEET	ZONE NAME	DEPOSIT NAME	DEPOSIT STATUS	UTM	COORDINATES		TYPE	Vfavor(m)
					E	N		
33F06	PG-221094	PG-221094	worked deposit	18	348023	5920071	Orogenic gold	0.781
33F06	Lac Atikamakuch-588	Lac Atikamakuch-588	worked deposit	18	343891	5910845	Gold-bearing iron formation	0.751
33F06	Bonspot	Bonspot	worked deposit	18	349031	5921040	Orogenic gold	0.731
33F06	Bonjoint	Bonjoint	worked deposit	18	348658	5922316	Orogenic gold	0.713
33F06	Massé	Massé	worked deposit	18	337263	5919559	Orogenic gold	0.731
33F06	Gordie/Benoit/Will/Pierre	Gordie/Benoit/Will/Pierre	worked deposit	18	338012	5918786	Orogenic gold	0.734
33F06	David	David	worked deposit	18	337324	5918967	Orogenic gold	0.706
33F09	TR-00-126	Wogogoosh	worked deposit	18	401687	5933170	Orogenic gold	0.806
33F09	TR-00-129, 130 et 131	Wogogoosh	worked deposit	18	402132	5933301	Orogenic gold	0.806
33F09	Orezone	Orezone	worked deposit	18	423904	5939174	Orogenic gold	0.729
33F09	Marylou	Marylou	worked deposit	18	411915	5936115	Orogenic gold	0.712
33F09	Grille KM 85 (LC-95-132)	Grille KM 85 (LC-95-132)	worked deposit	18	410602	5935714	Gold-bearing iron formation	0.713
33F10	Wedding	Wedding-Mylonite	worked deposit	18	393353	5931196	Orogenic gold	0.783
33F10	Tonalite-Zone Veine	Zone 32	worked deposit	18	396493	5932266	Orogenic gold	0.828
33F10	Mylonite	Wedding-Mylonite	worked deposit	18	393793	5931178	Orogenic gold	0.825
33F10	TRH-96-07	Wedding-Mylonite	worked deposit	18	393257	5931671	Orogenic gold	0.780
33F10	As-3	As-3	worked deposit	18	395695	5931743	Orogenic gold	0.837
33F10	As	As	worked deposit	18	395078	5931839	Orogenic gold	0.837
33F10	Indice 48 (TR-97-61)	Indice 48 (TR-97-61)	worked deposit	18	394142	5932340	Orogenic gold	0.800
33F10	Zone 35-L11W	Zone 35-L11W	worked deposit	18	394003	5931638	Orogenic gold	0.829
33F10	As-2	As-2	worked deposit	18	394510	5931613	Orogenic gold	0.824
33F10	Lac Cookeron	Lac Cookeron	worked deposit	18	400529	5933612	Orogenic gold	0.809
33F10	Lac Cookeron-Sud	Lac Cookeron-Sud	worked deposit	18	400277	5932335	Orogenic gold	0.796
33F10	Ugo	Ugo	worked deposit	18	398375	5932707	Orogenic gold	0.819
33G06	Lemoyne-Extension	Lemoyne-Extension	worked deposit	18	487670	5923565	Gold-bearing iron formation	0.734
33G06	Orfée est	Orfé	worked deposit	18	486138	5923399	Gold-bearing iron formation	0.758
33G06	PLE-98-05	PLE-98-05	worked deposit	18	486536	5923529	Gold-bearing iron formation	0.756
33G09	Golden-East & Golden-East II	Golden-East & Golden-East II	worked deposit	18	563886	5929512	Gold-bearing iron formation	0.727
33G09	Deca-Goose	Deca-Goose	worked deposit	18	564925	5929527	Orogenic gold	0.727
33G10	Rivière Pontois	Rivière Pontois	worked deposit	18	532089	5929589	Gold-bearing iron formation	0.735
33G11	Bertha	Bertha	worked deposit	18	487101	5928854	Orogenic gold	0.774
33G11	Lac Kristine-SO	Lac Kristine-SW	worked deposit	18	469397	5929179	Gold-bearing iron formation	0.722
33G12	Chiskamish Est	Chiskamish	worked deposit	18	437295	5946725	Gold-bearing iron formation	0.843
33G12	Chiskamish Ouest	Chiskamish	worked deposit	18	437010	5947000	Gold-bearing iron formation	0.841
33G12	Nutella	Nutella	worked deposit	18	441873	5947261	Orogenic gold	0.739
33G12	BBQ Nord	BBQ Nord	worked deposit	18	439869	5948741	Orogenic gold	0.701
33G12	Brèche 167	Brèche 167	worked deposit	18	437542	5947474	Orogenic gold	0.829
33H09	Bouchard	Bouchard	worked deposit	18	687122	5944615	Gold-bearing iron formation	0.753
33H09	Centre #2	Centre #2	worked deposit	18	676554	5939921	Orogenic gold	0.729
33H09	Lac Sirios Nord	Lac Sirios nord	worked deposit	18	667030	5939156	Gold-bearing iron formation	0.714
33H09	Lac Escale (Lamothe)	Lac Escale	worked deposit	18	686445	5943697	Gold-bearing iron formation	0.780

The 13 deposits highlighted in yellow were used to validate the results. The deposits are located on map A5.1 provided in Appendix 5.

APPENDIX 2 - WEIGHT-OF-EVIDENCE (WofE) ASSESSMENT FOR THE PARAMETERS USED

WEIGHTS-OF-EVIDENCE (WofE) ASSESSMENT FOR THE PARAMETERS USED											
Value or distance	Area (km²)	# Points	W+	s(W+)	W-	s(W-)	Contrast	s(Contr.)	Stud. contr.	Vfavor	Rank
Lithological control											
Reactivity											
5	80.60	5	4.4221	0.4618	-0.0722	0.1231	4.4942	0.4779	9.4041	0.758	16
4	6073.48	33	1.9284	0.1746	-0.5551	0.1623	2.4835	0.2383	10.4208	0.642	
0 - 3	83306.92	33	-0.6953	0.1741	2.057	0.1627	-2.7523	0.2383	-11.5489	0.307	
Proximity to felsic to intermediate dikes											
200	58	12	5.7958	0.3241	-0.1846	0.1302	5.9804	0.3493	17.1195	0.843	9
800	364.68	17	4.1214	0.2484	-0.2698	0.1361	4.3912	0.2832	15.5031	0.752	
1800	1192.88	9	2.2602	0.3346	-0.1222	0.127	2.3824	0.3579	6.6565	0.637	
> 1800	87972	33	-0.7484	0.1741	3.4135	0.1642	-4.1618	0.2393	-17.3918	0.208	
Proximity to a favourable lithology											
200	1265.8	62	4.1734	0.1302	-2.0519	0.3334	6.2253	0.3579	17.3947	0.857	8
400	1210.32	7	1.9926	0.3791	-0.0903	0.125	2.0828	0.3992	5.2181	0.619	
> 400	87111.44	2	-3.5423	0.7071	3.5874	0.1221	-7.1297	0.7176	-9.9358	0.001	
Lithological diversity											
11 - 15	206.24	4	3.2163	0.5049	-0.0557	0.1222	3.2721	0.5195	6.2985	0.688	17
8 - 10	1863.48	34	3.1541	0.1731	-0.6311	0.1644	3.7852	0.2387	15.8548	0.717	
5 - 7	9877.60	24	1.122	0.2044	-0.2959	0.1459	1.4179	0.2511	5.6464	0.581	
3 - 4	23424.44	8	-0.8423	0.3536	0.1837	0.126	-1.026	0.3754	-2.7329	0.428	
0 - 2	54215.80	1	-3.7612	1	0.9163	0.1196	-4.6775	1.0071	-4.6444	0.172	
Structural control											
Proximity to a local fault or shear zone											
200	190.44	29	5.4227	0.2017	-0.5232	0.1543	5.9459	0.254	23.4122	0.841	10
400	247.60	7	3.6023	0.3834	-0.1011	0.125	3.7034	0.4033	9.1827	0.712	
1400	2799.60	14	1.8463	0.2679	-0.188	0.1325	2.0344	0.2989	6.8061	0.617	
> 1400	86349.92	21	-1.1819	0.2182	2.9845	0.1425	-4.1664	0.2607	-15.9839	0.208	
Proximity to mapped Archean faults											
200	2235.88	22	2.528	0.2143	-0.3458	0.1429	2.8739	0.2575	11.159	0.665	21
800	3496.92	12	1.4682	0.2892	-0.1454	0.1302	1.6136	0.3171	5.088	0.592	
> 800	83854.76	37	-0.586	0.1644	2.0178	0.172	-2.6038	0.238	-10.9422	0.317	
Density of mapped Archean fault											
0.51 - 1.46	1346.92	26	3.2115	0.198	-0.4412	0.1491	3.6527	0.2479	14.7347	0.709	18
0.38 - 0.51	1091.04	3	1.246	0.5781	-0.0309	0.1213	1.2769	0.5907	2.1616	0.573	
< 0.38	87149.60	42	-0.4977	0.1543	2.7198	0.1868	-3.2176	0.2423	-13.2782	0.274	
Proximity to a local fold hing											
200	50.28	6	5.1407	0.435	-0.0878	0.1241	5.2285	0.4524	11.5579	0.800	14
600	198.68	12	4.395	0.2978	-0.1831	0.1302	4.5781	0.325	14.0847	0.762	
2800	2987.24	25	2.3647	0.2008	-0.4004	0.1475	2.7651	0.2492	11.0969	0.658	
> 2800	86351.36	28	-0.8942	0.189	2.8319	0.1535	-3.7261	0.2435	-15.3018	0.239	
Proximity to quartz veins											
200	245.40	33	5.2775	0.1871	-0.6227	0.1623	5.9003	0.2477	23.8235	0.838	11
800	1515.92	11	2.2209	0.3026	-0.1514	0.1291	2.3723	0.329	7.2102	0.636	
> 800	87826.24	27	-0.9475	0.1925	3.4752	0.1527	-4.4226	0.2457	-18.0017	0.190	
Hydrothermal activity											
Indicator metals in rock											
Proximity to a gold anomaly > 50 ppb											
200	105.96	51	7.0647	0.1944	-1.2663	0.2236	8.3311	0.2963	28.1137	0.977	2
400	116.24	3	3.5086	0.5849	-0.0419	0.1213	3.5505	0.5974	5.9433	0.703	
1200	913.52	10	2.6358	0.3180	-0.1417	0.1281	2.7774	0.3428	8.1022	0.659	
> 1200	88451.84	7	-2.3047	0.3780	4.3214	0.1287	-6.6261	0.3993	-16.5950	0.035	
Proximity to a silver anomaly >= 3 ppm											
400	88.32	16	5.6310	0.2763	-0.2545	0.1349	5.8855	0.3074	19.1435	0.837	12
2000	1278.40	19	2.9455	0.2311	-0.2973	0.1387	3.2428	0.2696	12.0296	0.686	
3200	1487.44	12	2.3277	0.2898	-0.1685	0.1302	2.4962	0.3178	7.8557	0.643	
> 3200	86733.40	24	-1.0528	0.2042	3.0497	0.1471	-4.1025	0.2516	-16.3045	0.212	
Proximity to an arsenic anomaly > 8 ppm											
200	129.96	28	5.8471	0.2134	-0.5003	0.1525	6.3475	0.2623	24.2014	0.864	6
1200	1257.00	16	2.7884	0.2516	-0.2414	0.1349	3.0298	0.2855	10.6130	0.674	
> 1200	88200.60	27	-0.9517	0.1925	3.7211	0.1532	-4.6728	0.2460	-18.9944	0.172	

Value or distance = Identifier for specific classes or attribute values

Area = Area of each class in km²

Point = Number of training points that fall within the area of the class

W+ = Value of W+

s(W+) = Standard deviation of W+

W- = Value of W-

s(W-) = Standard deviation of W-

Contrast = Contrast (difference between W+ and W-)

s(Contr.) = Standard deviation of Contrast

Stud. contr. = Studentized contrast (C divided by s(Contr.))

Vfavor¹⁴ = Calculated value of favorability

Rank = Rank of the favorability parameter

14- The Vfavor parameter is not calculated by ArcSDM. See the "Methodology" section.

APPENDIX 2 (continued)

WEIGHTS-OF-EVIDENCE (WofE) ASSESSMENT FOR THE PARAMETERS USED											
Value or distance	Area (km²)	# Points	W+	s(W+)	W-	s(W-)	Contrast	s(Contr.)	Stud. contr.	Vfavor	Rank
Hydrothermal activity											
Indicator metals in rock											
Proximity to an antimony anomaly >= 15 ppm											
200	14.96	12	8.5392	0.6490	-0.1851	0.1302	8.7243	0.6619	13.1804	1.000	1
800	96.72	10	4.9794	0.3340	-0.1508	0.1281	5.1302	0.3577	14.3430	0.794	
2400	594.08	8	2.8455	0.3560	-0.1130	0.1260	2.9585	0.3776	7.8347	0.670	
3000	343.20	3	2.4086	0.5799	-0.0394	0.1213	2.4479	0.5924	4.1319	0.640	
> 3000	88538.60	38	-0.6137	0.1623	3.7124	0.1769	-4.3261	0.2400	-18.0231	0.192	
Proximity to a boron anomaly >= 75 ppm											
200	12.40	6	7.0750	0.5683	-0.0882	0.1241	7.1632	0.5816	12.3154	0.911	4
600	47.52	4	4.7526	0.5225	-0.0575	0.1222	4.8101	0.5366	8.9644	0.776	
3000	786.52	11	2.8839	0.3036	-0.1596	0.1291	3.0435	0.3300	9.2237	0.674	
> 3000	88741.12	50	-0.3414	0.1415	3.4681	0.2210	-3.8095	0.2624	-14.5192	0.228	
Proximity to a molybdenum anomaly >= 22 ppm											
200	19.40	5	6.0817	0.5191	-0.0729	0.1231	6.1546	0.5335	11.5365	0.853	7
1400	370.48	12	3.7425	0.2935	-0.1811	0.1302	3.9237	0.3211	12.2207	0.725	
3200	1200.48	12	2.5440	0.2901	-0.1718	0.1302	2.7158	0.3180	8.5396	0.656	
> 3200	87997.20	42	-0.5074	0.1543	3.1535	0.1874	-3.6609	0.2428	-15.0788	0.239	
Proximity to a lithochemical alteration indices											
200	217.20	23	5.0061	0.2205	-0.3893	0.1444	5.3954	0.2636	20.4701	0.809	13
800	1117.08	18	3.0276	0.2376	-0.28	0.1374	3.3077	0.2745	12.0503	0.690	
1200	1099.56	9	2.3423	0.3347	-0.1233	0.127	2.4656	0.358	6.8869	0.641	
> 1200	87153.72	21	-1.1912	0.2182	3.2751	0.1429	-4.4662	0.2609	-17.1209	0.182	
Proximity to an anomalous NORMAT ISER index											
1000	215.44	16	4.6166	0.2598	-0.2531	0.1349	4.8697	0.2928	16.6339	0.779	15
2000	379.32	10	3.5304	0.3205	-0.1477	0.1281	3.6781	0.3451	10.6572	0.711	
5000	1693.72	15	2.4218	0.2593	-0.2184	0.1337	2.6402	0.2918	9.0487	0.651	
> 5000	87299.08	30	-0.8361	0.1826	3.1355	0.1576	-3.9716	0.2412	-16.4655	0.217	
Observed mineralization											
Proximity to an alteration minerals observation											
200	819.72	60	4.6009	0.1341	-1.8563	0.3015	6.4572	0.33	19.5668	0.870	5
400	946.80	3	1.3882	0.5783	-0.0326	0.1213	1.4208	0.5909	2.4046	0.581	
> 400	87821.04	8	-2.164	0.3536	3.8422	0.1283	-6.0062	0.3761	-15.9686	0.072	
Proximity to a local sulphide occurrence											
200	422.12	63	5.399	0.1366	-2.1792	0.3536	7.5782	0.379	19.9933	0.934	3
400	508.36	2	1.6054	0.7085	-0.0229	0.1204	1.6283	0.7187	2.2657	0.593	
> 400	88657.08	6	-2.4612	0.4083	4.5506	0.1286	-7.0118	0.428	-16.3812	0.001	
Geophysical evidence											
Proximity to a favourable value for the residual magnetic field											
1000	2537.36	18	2.1981	0.2365	-0.2638	0.1374	2.462	0.2736	8.9999	0.641	23
3000	4908.24	10	0.9455	0.3166	-0.0955	0.1281	1.041	0.3415	3.0484	0.560	
6000	9490.48	25	1.203	0.2003	-0.3223	0.1475	1.525	0.2487	6.1326	0.587	
> 6000	72651.48	18	-1.1633	0.2357	1.3757	0.1376	-2.539	0.2729	-9.3025	0.319	
Proximity to a favourable value for the vertical magnetic gradient											
400	2454.32	19	2.2861	0.2303	-0.2839	0.1387	2.57	0.2689	9.5588	0.647	22
800	1988.04	5	1.1566	0.4478	-0.0506	0.1231	1.2072	0.4644	2.5994	0.569	
> 800	85145.20	47	-0.3619	0.1459	1.924	0.2047	-2.2859	0.2514	-9.0943	0.337	
Secondary environment (lake bottom sediments)											
Proximity to an arsenic anomaly											
400	220.04	5	3.3781	0.4524	-0.0706	0.1231	3.4487	0.4688	7.3558	0.698	19
2000	3987.20	14	1.4912	0.2677	-0.1742	0.1325	1.6655	0.2987	5.5752	0.595	
> 2000	85380.32	52	-0.2635	0.1387	1.7439	0.2299	-2.0074	0.2685	-7.4754	0.357	
Proximity to an antimony anomaly											
800	335.12	7	3.292	0.382	-0.1001	0.125	3.3922	0.4019	8.4398	0.694	20
2000	1668.56	9	1.9224	0.3342	-0.1168	0.127	2.0392	0.3576	5.7031	0.617	
> 2000	87583.88	55	-0.2329	0.1349	2.3174	0.251	-2.5503	0.2849	-8.9498	0.318	

Value or distance = Identifier for specific classes or attribute values

Area = Area of each class in km²

Point = Number of training points that fall within the area of the class

W+ = Value of W+

s(W+) = Standard deviation of W+

W- = Value of W-

s(W-) = Standard deviation of W-

Contrast = Contrast (difference between W+ and W-)

s(Contr.) = Standard deviation of Contrast

Stud. contr. = Studentized contrast (C divided by s(Contr.))

Vfavor¹⁴ = Calculated value of favorability

Rank = Rank of the favorability parameter

14- The Vfavor parameter is not calculated by ArcSDM. See the "Methodology" section.

APPENDIX 3 - INFERENCE MODEL OF THE POTENTIAL FOR OROGENIC GOLD DEPOSITS IN THE BAIE-JAMES REGION

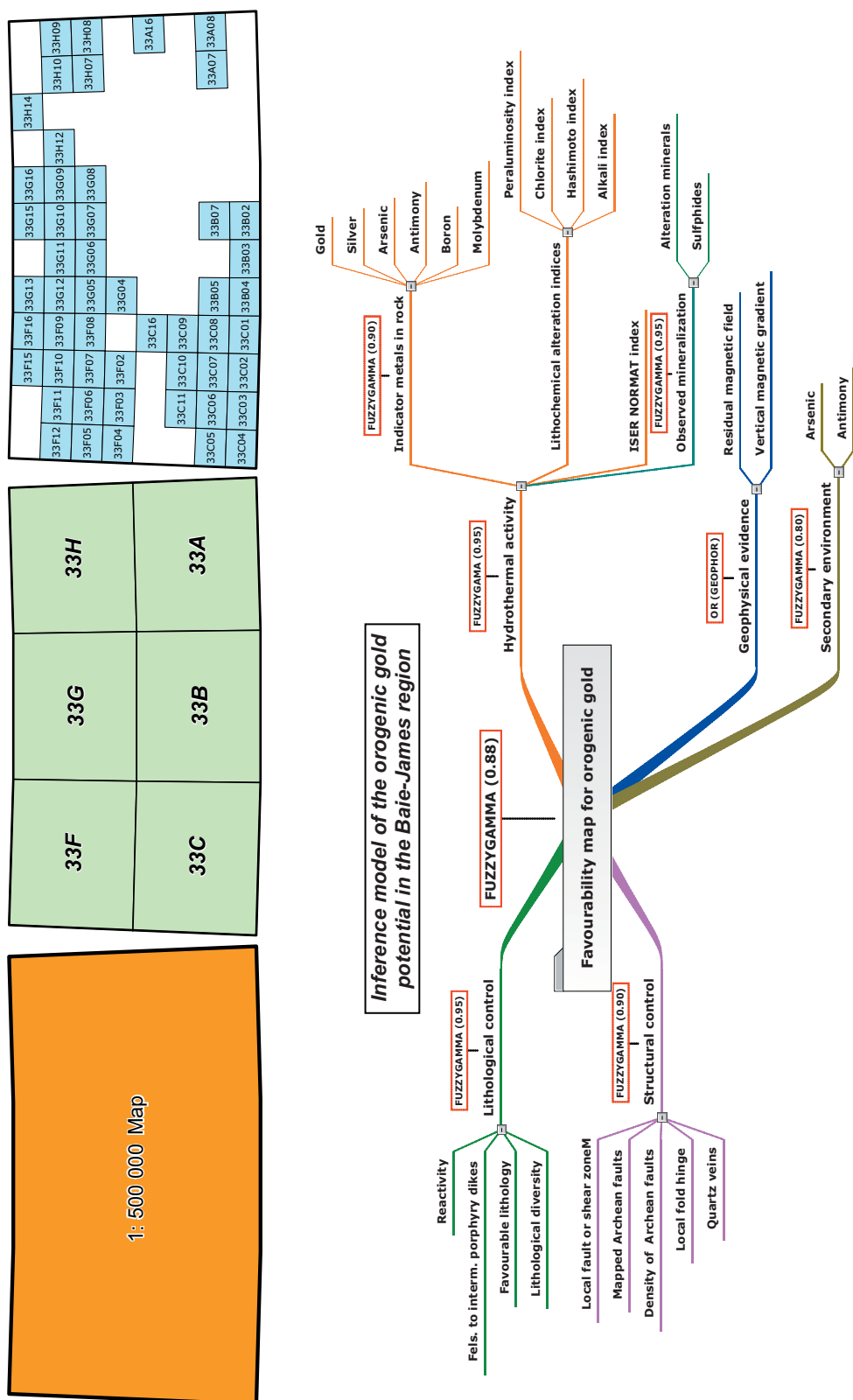


Figure A3.1 - Inference model illustrating the process by which the parameters were combined. The various parameters and the submodels were all combined using FUZZYGAMMA operators, with the exception of the two parameters of the “geophysical evidence” submodel, which were combined using an OR operator. The anomalous points of the different indices of the “alteration indices” parameter were not combined using an operator, but were instead grouped together to create the parameter map. The figure shown in parentheses after the FUZZYGAMMA operators is the factor used to calibrate the parameter or the submodel so that the background value of the final map would be about 0.5.

APPENDIX 4 - NORMALIZED ARSENIC DATA FOR LAKE BOTTOM SEDIMENTS SAMPLED IN PART OF THE BAIE-JAMES TERRITORY

By M. Beaumier

Sampling

Sediment sampling in the lakes on NTS sheets 33A, 33B, 33C, 33F, 33G, 33H was conducted either by the SDBJ in the 1970s or by the MRNF in 1997. A small part of the southern sector of sheet 33A has never undergone lake bottom sediment sampling. The sampling done by the SDBJ in the 1970s comprises various campaigns. At least 5 separate projects can be identified as a function of the year of sampling (1973, 1974, 1975, 1976 and 1978). In most cases, the samples did not come from the deep part of the lake (C. Gleeson, pers. comm.). This results in a more heterogeneous sample population and lower reproducibility.

The various sampling years are differentiated by the unique identification number assigned in the files (Table A4.1).

Table A4.1 - Identification number range for each sampling year.

Year	First identification number	Last identification number	Number of samples
1973	1957000078	1957005503	4143
1974	1957005507	1957014998	7321
1975	1957024201	1957033137	8260
1976	1957060001	1957081361	11777
1978	1957083054	1957187696	4645

Although most of the sampling was performed in a contiguous and complete geometric block, when this was not the case (sampling of a set of distinct blocks) the arsenic analysis was performed using a consistent method and so the sampling can still be considered to have been performed in a contiguous block.

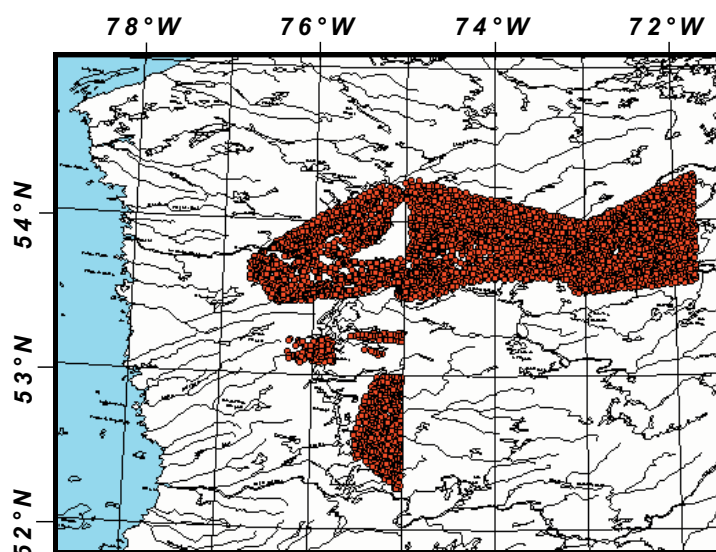


Figure A4.1- Sampling site locations for the 1973 campaign.

During a given year, several sampling campaigns may be conducted with different methods being used for arsenic analysis, at different laboratories (R. Blais, pers. comm.). Figure A4.2 presents the 1974 sampling campaign which was carried out in two separate blocks. The arsenic determination for the sampling sites in blue was performed using hydride generation (analytical detection limit of 0.1 ppm and an analytical precision of 0.1 ppm). The arsenic analysis method for the sampling performed in the eastern sector (in red) had a detection limit of 0.5 ppm and an analytical precision of 0.5 ppm. In this case, the geochemical data need to be normalized separately for each block.

A more complex situation arises for 1978, when in addition to complete sampling of a contiguous sector, a number of sites defined as anomalous in sampling campaigns of earlier years were verified. These verification sites are distributed either in blocks with a finer grid (Figure A4.3) or they are scattered across a vast area (Figure A4.4). At the time, the SDBJ decided to renumber all the samples using a uniform and continuous sequence (Y. Pelletier, pers. comm.).

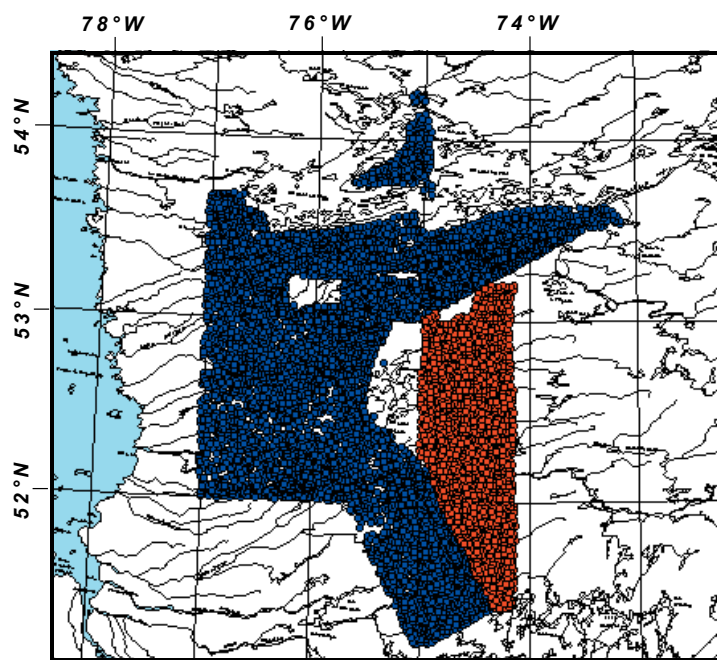


Figure A4.2 - Location of the two sampling blocks (east and west) of the 1974 campaign.

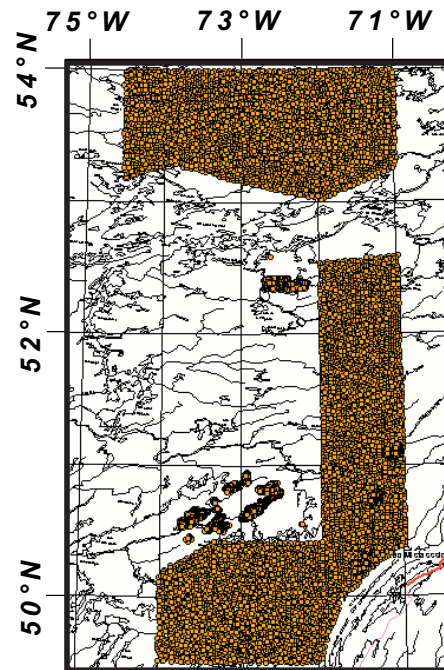


Figure A4.3 - Location of the lake sediment sampling campaign conducted in summer 1976, and location of follow-up sampling of the anomalous sector defined in earlier sampling campaigns.

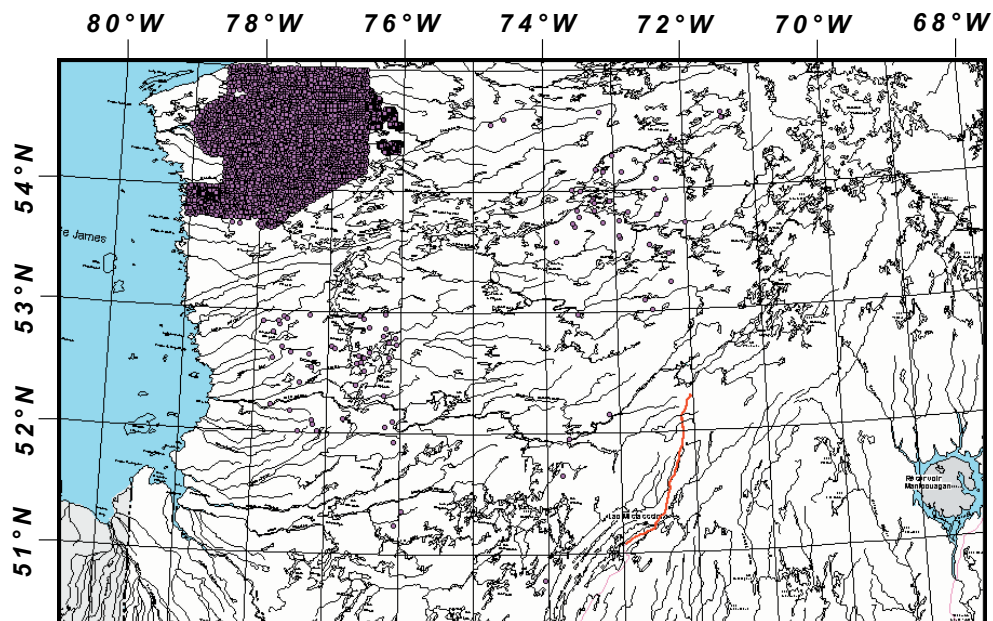


Figure A4.4 - Location of the 1978 sampling campaign and the sites included in the follow-up.

In general, sampling density is uniform, with about 1 sample per 6 km² across the total area covered. Two exceptions are:

- In the follow-up, as shown above (Figure A4.3 and A4.4), density reaches 1 sample per km² locally.
- In the eastern part of the 1976 sampling campaign (Figure A4.5), sampling density was only 1 sample per 20 km². The latter represents re-sampling which was required because of a fire that destroyed all of the samples from this sector (Y. Pelletier, pers. comm.).

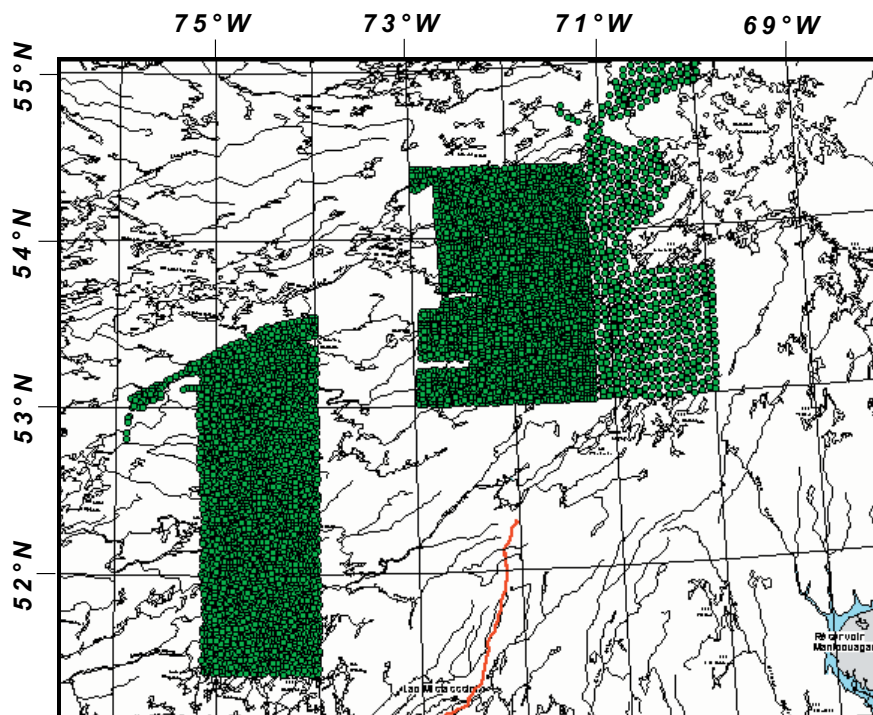


Figure A4.5 - Location of the 1975 sampling campaign and the sector east of it which has a lower sampling density.

Arsenic analyses

Two analytical methods were used for arsenic determination in the lake sediments. The first method involves hydride generation followed by atomic absorption spectrometry (AA). This approach was used in all the sampling work done by the SDBJ. Depending on the protocol used, the analytical detection limit can vary between 0.1 ppm and 0.5 ppm and can even be 1.0 ppm. The analytical precision shows similar variability.

The second analytical method used is neutron activation (NA). The MRNF used this approach for the survey in the northern sector of sheet 33A. This technique involves bombarding a sample with neutrons and then examining the emission spectra. Since the mass of each sample varies, the contents of each 10 mL capsule varies in weight. In order to ensure a uniform detection limit, the time devoted to monitoring the emitted radiation is adjusted.

Between 1984 and 1996, le MRNF re-analysed most of the samples collected by the SDBJ, including all of the chemical elements analysed by neutron activation. These elements are Au, As, Sb, Se, Tm, U, W, Br, Cs. Nonetheless, for more than one third of the pulps from SDBJ samples, the amounts available were too small to permit analysis.

For arsenic, the detection limit of this analytical method is 1 ppm and analytical precision is 1 ppm. This should be adequate, since in the exploration work carried out west of Schefferville an arsenic level of 3 ppm is considered a clear indicator of arsenic mineralization (Beaumier, 1987). These analyses nonetheless help to provide an overview of arsenic distribution in lake bottom sediments within the Baie-James region. At sites for which neutron activation analysis was not performed, we can use the arsenic level determined by the atomic absorption (AA) method. The two methods are not perfectly compatible. However, given that two analytical results are available for a number of sites, a relationship can be established between the arsenic content determined by AA and that determined by NA.

The equation expressing this relationship can be used to convert the arsenic levels determined by AA into equivalent NA results levels. This calculation should be performed for each year and, in some cases, for the portions of years during which the same analytical method was used with the same detection limit and the same analytical precision.

Sampling done by the SDBJ

1973

La figure A4.6 permet d'établir la relation entre l'arsenic mesuré par AA et celui mesuré par AN; cette relation permet ensuite de niveler aux teneurs mesurées par AN les teneurs de l'arsenic pour AA.

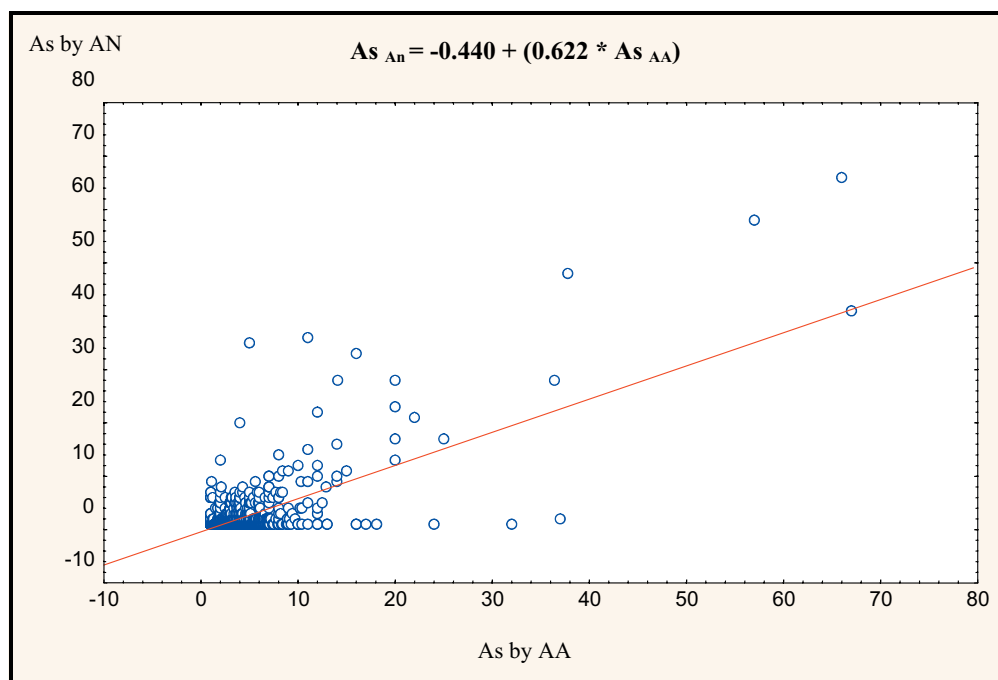


Figure A4.6 - Relationship between the arsenic levels determined by atomic absorption and the levels determined by neutron activation, for all the samples collected during 1973.

This results in changes in levels that amount to a few ppm (Table A4.2), for example. Therefore, for sectors yielding levels higher than 3 ppm as determined by atomic absorption, the values obtained will be greater than 1 ppm, which statistically results in a response on the overall favourability map.

Table A4.2 - Changes in arsenic levels (in ppm) as a result of the various regressions performed on the arsenic levels obtained by AA.

Original level determined by AA	0.1 ppm	1.0 ppm	2.0 ppm	3.0 ppm	10.0 ppm
Level calculated for NA	-0.377	0.182	0.804	1.426	5.78

1974

We grouped the samples from the 1974 sampling campaign in two blocks (Figure A4-2):

- Western portion;
- Eastern portion.

These two sectors are necessary in view of the analytical difference in the original arsenic analysis:

- For the eastern sector, the analytical detection limit and the analytical precision are 0.5 ppm;
- For the western sector, the analytical detection limit and the analytical precision are 0.1 ppm.

In each of these sectors, we calculated the regression for sites where arsenic determination had been performed by both analytical methods. The resulting equation (Figure A4.7) can be used to express the arsenic level determined by AA as a value obtained by NA for the eastern part of the area.

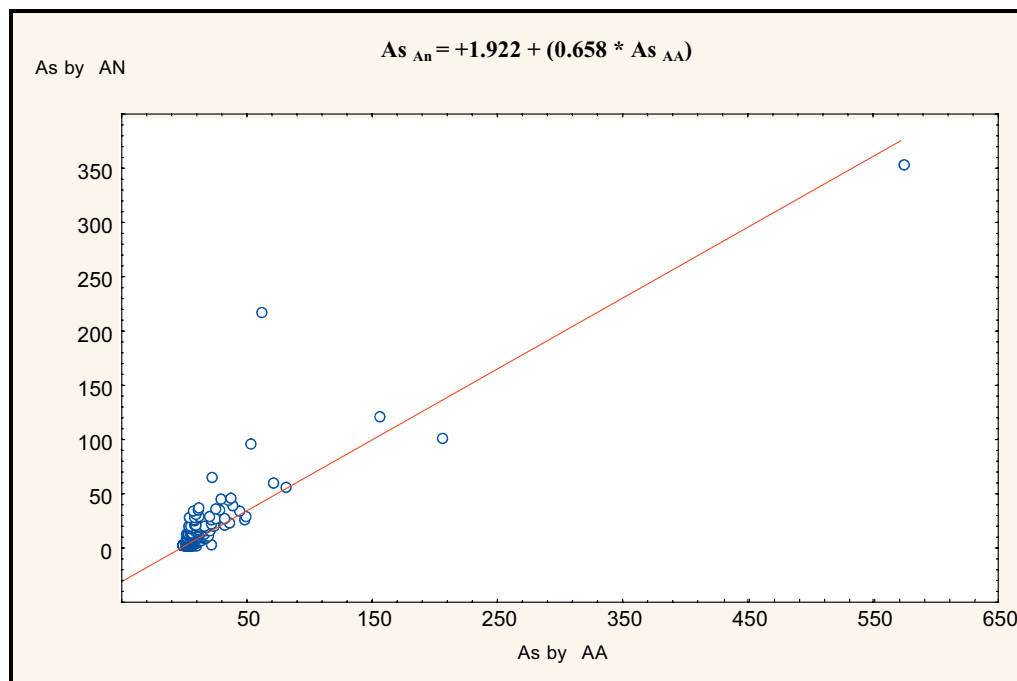


Figure A4.7 - Relationship between arsenic levels determined by AA and the levels determined by NA in the northern part of the lake sediment sampling campaign in 1974 (eastern portion).

The equation displayed on Figure A4.8 is used to derive the arsenic content of AA assays normalized to neutron activation assays for the western part of the 1974 territory.

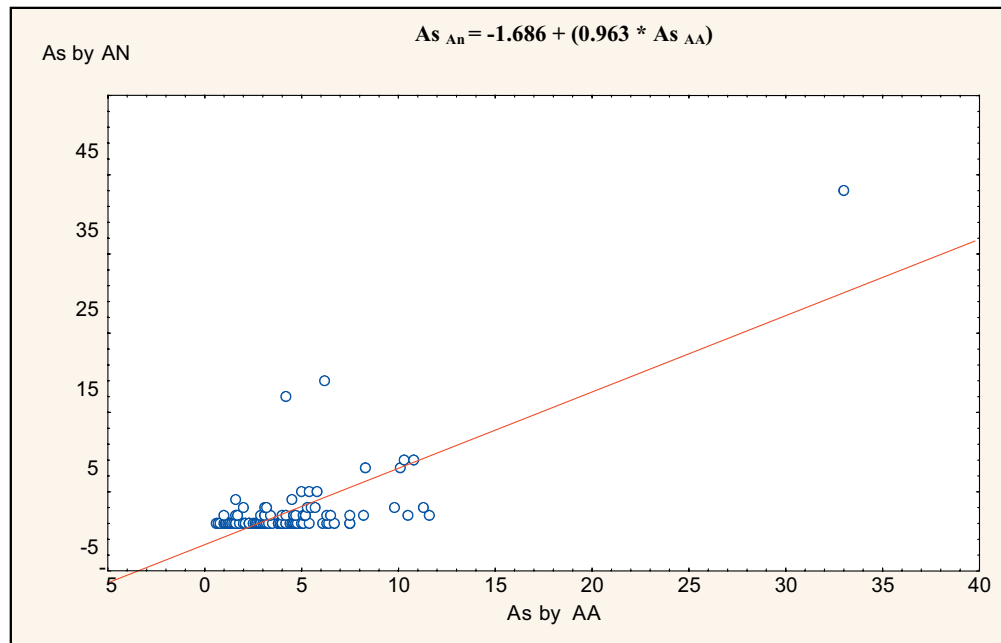


Figure A4.8 - Relationship between arsenic levels determined by AA and the levels determined by NA in the northern part of the lake sediment sampling campaign in 1974 (western portion).

This approach results in changes in the levels of arsenic in the order of a few ppm (Table A4.3).

Table A4.3 - Changes in arsenic levels (in ppm) as a result of the various regressions performed on the arsenic levels obtained by AA.

Original level determined by AA in ppm (1974 E)	0.1	1	2	3	10
Level recalculated as a function of NA in ppm (1974 E)	*	2.58	3.2	3.8	8.5
Original level determined by AA in ppm (1974 W)	0.1	1	2	3	10
Level recalculated as a function of NA in ppm (1974 W)	-1.58	-0.7	0.24	1.2	7.9

* the analytical detection limit is 0.5 ppm

1975

For 1975, the analytical method for arsenic was consistent with an analytical detection limit of 0.5 ppm and analytical precision of 0.5 ppm. The same method was used to adjust the As levels (Figure A4.9)

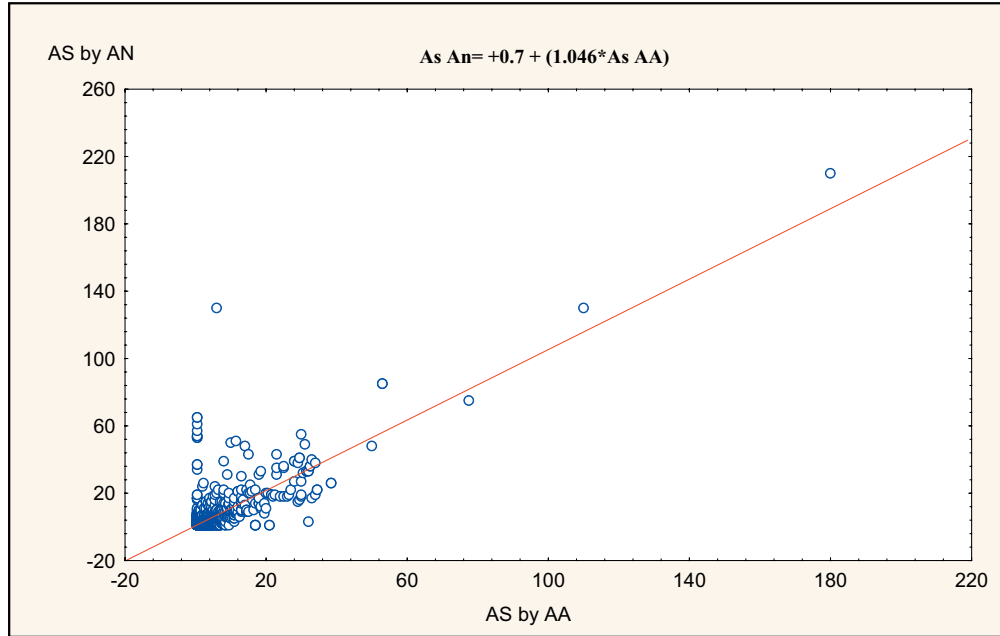


Figure A4.9 - Relationship between arsenic levels determined by AA and levels determined by NA in the northern part of the lake sediment sampling campaign in 1975.

This results in changes in the arsenic level in the order of a few ppm (Table A4.4). For sectors with levels of more than 3 ppm determined by atomic absorption, a result of over 3 ppm will be obtained.

Table A4.4 - Changes in arsenic levels (in ppm) as a result of the various regressions performed on the arsenic

Original level determined by AA in ppm	0.1	1	2	3	10
Level recalculated as a function of NA in ppm	0.8	1.7	2.7	3.8	11.1

levels obtained by AA.

1976 and 1978

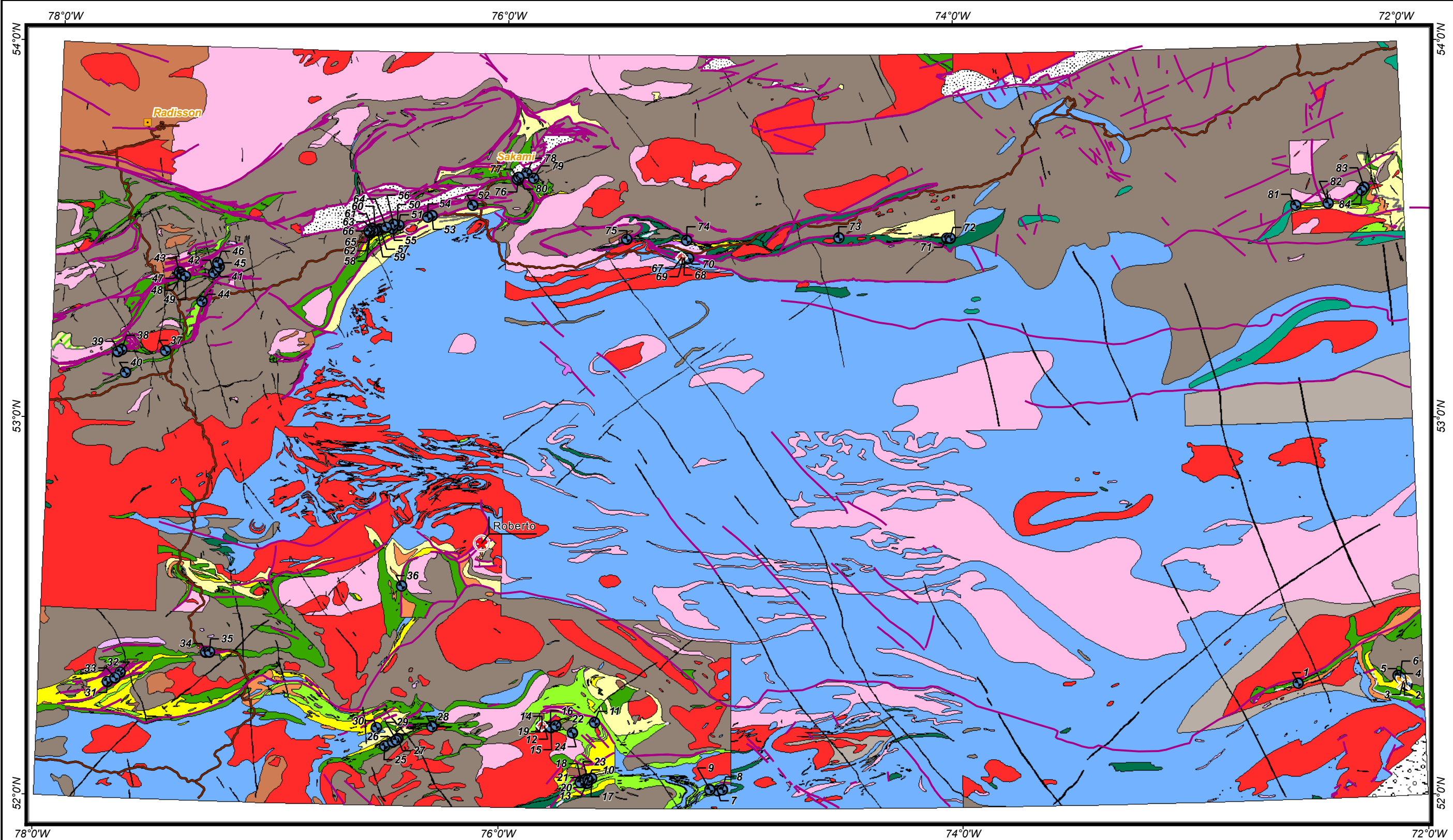
In 1976 and 1978 arsenic determination was not performed by AA. We therefore used the results of the re-analysis by NA carried out during the 1990s.

References

BEAUMIER, M., 1987 – Géochimie des sédiments de lac dans la région de Schefferville – Données complémentaires. Ministère des Ressources naturelles; MB-87-32, 407 pages.

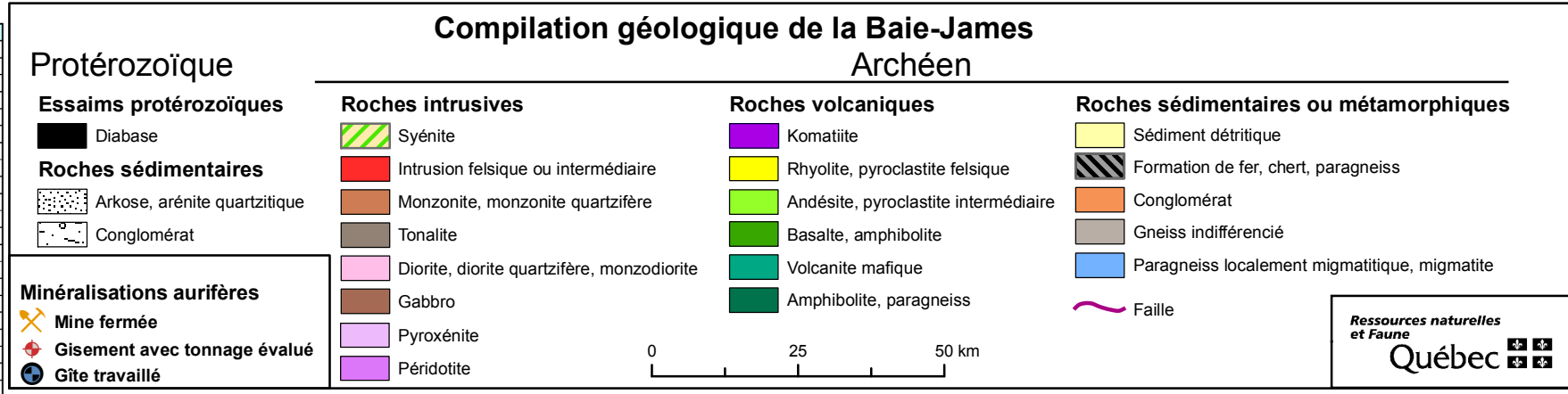
APPENDIX 5- GEOLOGICAL MAP AND FAVORABILITY MAPS OF EACH PARAMETER

A5.1-	Geology
A5.2-	Reactivity
A5.3-	Proximity to felsic dikes
A5.4-	Proximity to a favourable lithology
A5.5-	Lithological diversity
A5.6-	Proximity to a local fault or shear zone
A5.7-	Proximity to mapped Archean faults
A5.8-	Density of mapped Archean faults
A5.9-	Proximity to a local fold hinge
A5.10-	Proximity to quartz veins
A5.11-	Proximity to a gold anomaly
A5.12-	Proximity to a silver anomaly
A5.13-	Proximity to an arsenic anomaly
A5.14-	Proximity to an antimony anomaly
A5.15-	Proximity to a boron anomaly
A5.16-	Proximity to a molybdenum anomaly
A5.17-	Proximity to lithochemical indices
A5.18-	Proximity to an anomalous ISER index
A5.19-	Proximity to a mineral indicator of alteration
A5.20-	Proximity to a mineral indicator of mineralization
A5.21-	Proximity to a favourable value for the residual magnetic field
A5.22-	Proximity to a favourable value for the vertical magnetic gradient
A5.23-	Proximity to an arsenic anomaly
A5.24-	Proximity to an antimony anomaly
A5.25-	Favorability of lithological control
A5.26-	Favorability of structural control
A5.27-	Favorability of indicator metals in rock
A5.28-	Proximity to a mineral indicator of alteration or mineralization
A5.29-	Favorability of hydrothermal activity
A5.30-	Favorability of geophysical evidence
A5.31-	Favorability of secondary environmental evidence
A5.32-	Favorability in orogenic gold type mineralization

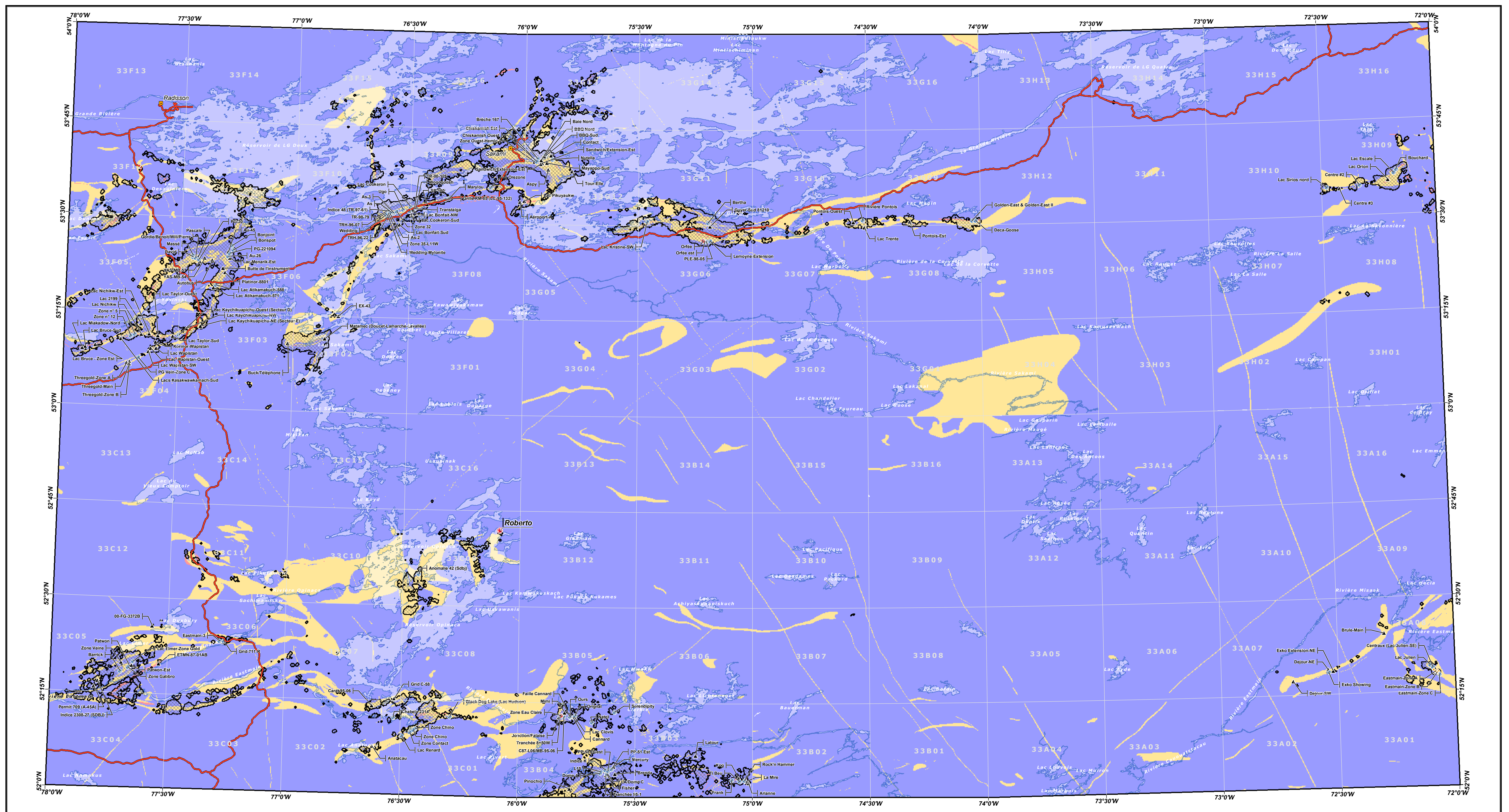


Identification des gîtes de type orogénique utilisés pour le traitement

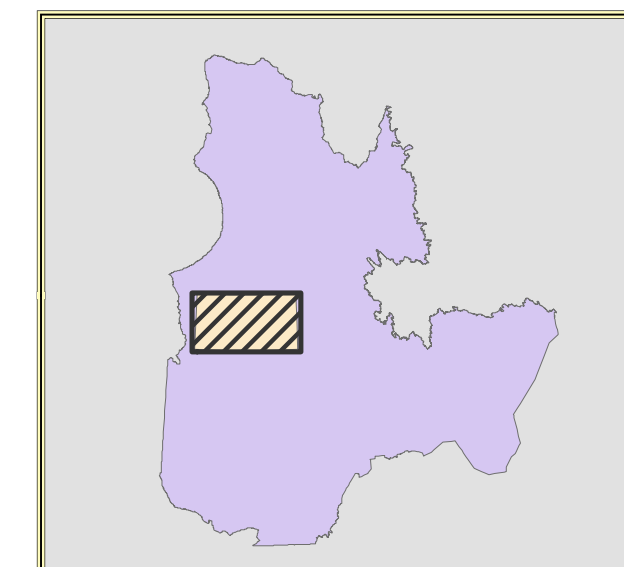
#	Gîte	#	Gîte	#	Gîte	#	Gîte
1	Exko Showing	22	Orignal	43	David	64	Ugo
2	Zone B	23	PP-51 Ouest	44	Lac Atikamouch-588	65	Wedding
3	Zone A	24	Natel	45	Bonspot	66	TRH-96-07
4	Zone C	25	Lac Renard	46	Bonjoint	67	Orfée
5	Lac Julien	26	Zone Contact	47	Massé	68	PLE-98-05
6	Centraux (Lac Julien-SE)	27	Zone Chino Est	48	Gordie/Benoit/Will/Pierre	69	Orfée est
7	Ti Beu	28	Black Dog Lake (Lac Hudson)	49	PG-30	70	Lemoyne-Extension
8	Rock'n Hammer	29	Zone Chino	50	TR-00-126	71	Golden-East & Golden-East II
9	Frank	30	Chabela 2314	51	TR-00-129, 130 et 131	72	Deca-Goose
10	Fisher	31	Barrick	52	Orezone	73	Rivière Pontois
11	Serendipity	32	Lac Elmer-Zone Gold	53	Mariou	74	Bertha
12	C87-L06/MB-95-06	33	Zone Gabbro	54	Grille KM 85 (LC-95-132)	75	Lac Kristine-SO
13	LA/Dome C	34	Eastmain-3	55	Lac Cookeron-Sud	76	Chiskamish Est
14	Zone Eau Claire	35	Grid-711-R	56	Lac Cookeron	77	Chiskamish Ouest
15	Faillle Cannard	36	Anomalie 42 (Sdbj)	57	Tonalite-Zone Veine	78	BBQ Nord
16	Ours	37	Lac Kaychikuapichu-Ouest (Secteur D)	58	Mylonite	79	Nutella
17	PP-51 Est	38	Zone n° 5	59	As-3	80	Brèche 167
18	L15	39	Zone n° 12	60	As	81	Lac Sirios Nord
19	Tranchée B+50W	40	PG Vein-Zone C	61	Indice 48 (TR-97-61)	82	Centre #2
20	Indice K	41	PG-221094	62	Zone 35-L11W	83	Bouchard
21	Dome A	42	Au-26	63	As-2	84	Lac Escalpe (Lamothe)



Potentiel en minéralisations de type or orogénique de la Baie-James



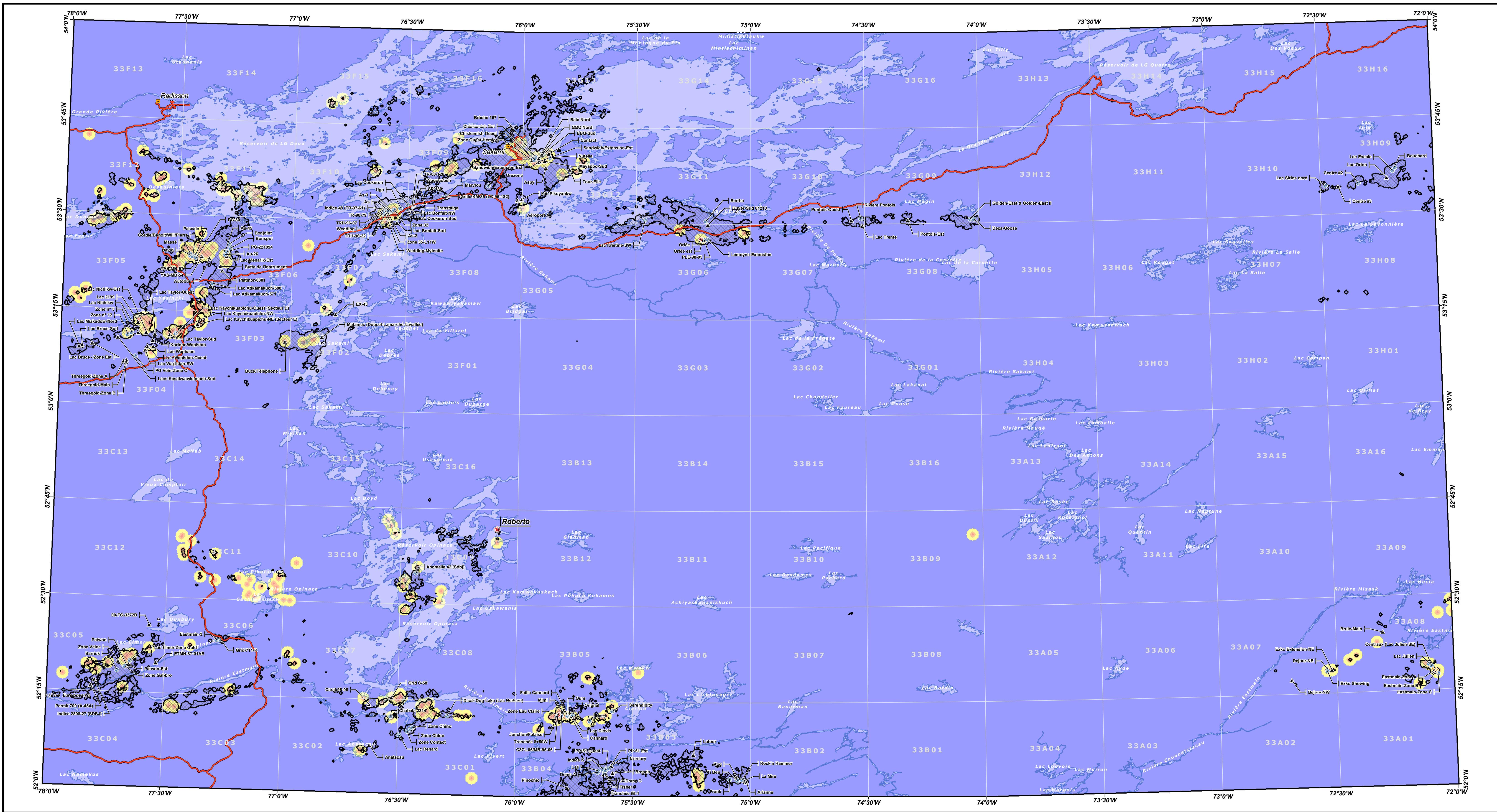
A horizontal scale bar with a red and white checkered pattern. It is marked with numbers 0, 10, 20, 30, 40, and 50. The unit 'km' is at the right end. Below the bar is the text '1:500 000'.



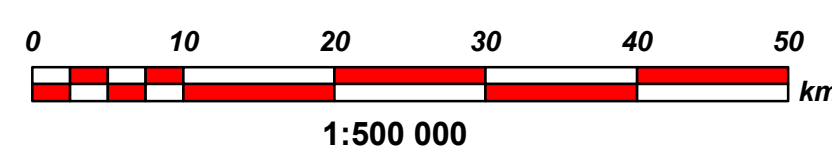
Projection : UTM NAD83, zone 18N
Source : EP 2008-01, MRNFQ

ressources naturelles
Faune
Québec

Potentiel en minéralisations de type or orogénique de la Baie-James

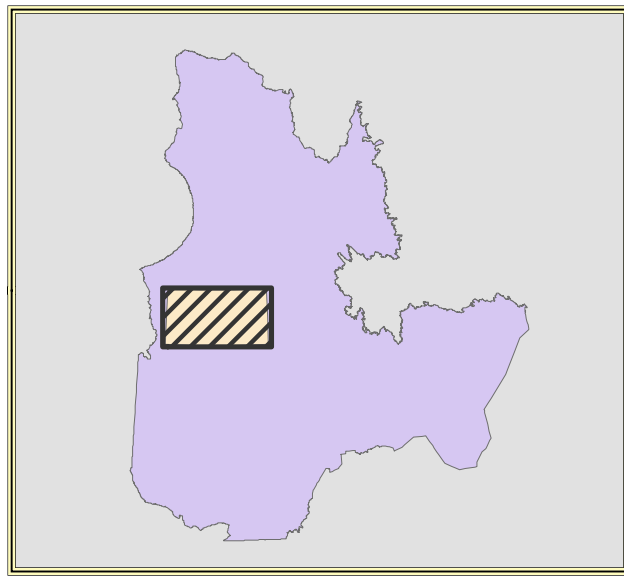


- Village ou lieu-dit
 - Route
 - Minéralisations aurifères de type or orogénique
 - Mine fermée
 - Gisement avec tonnage évalué
 - Gîte travaillé
 - Indice, aucun travail
 - Gîte Roberto (gîte aurifère de remplacement)
- Zone de haute favorabilité**
- Favorabilité**
- 0,843
- 0,208



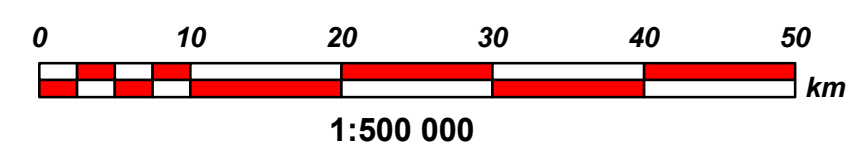
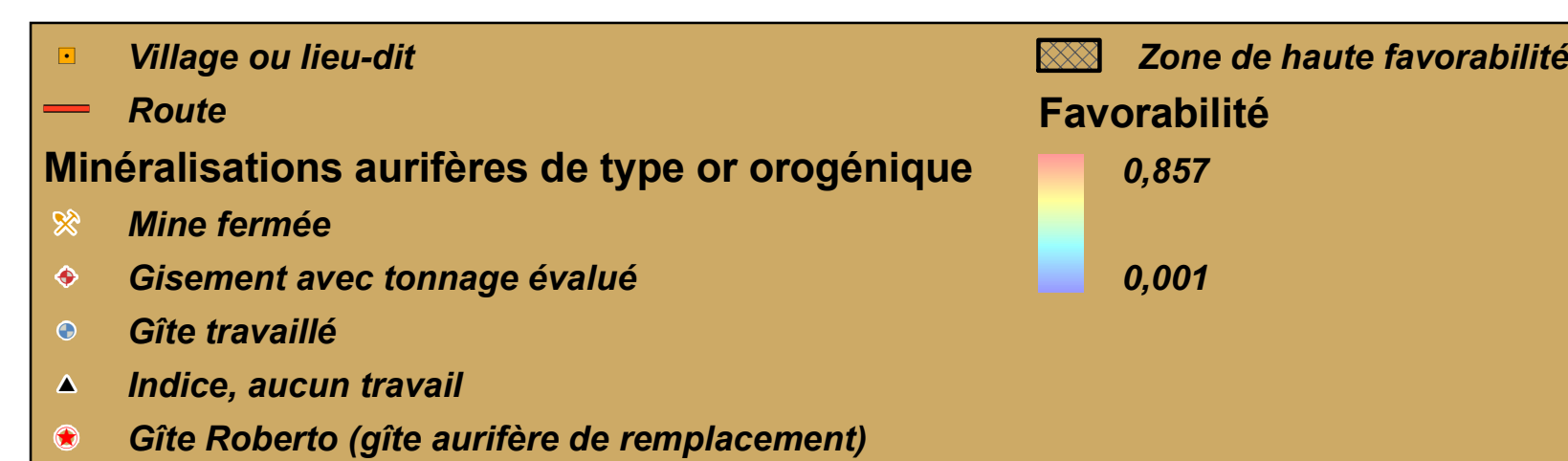
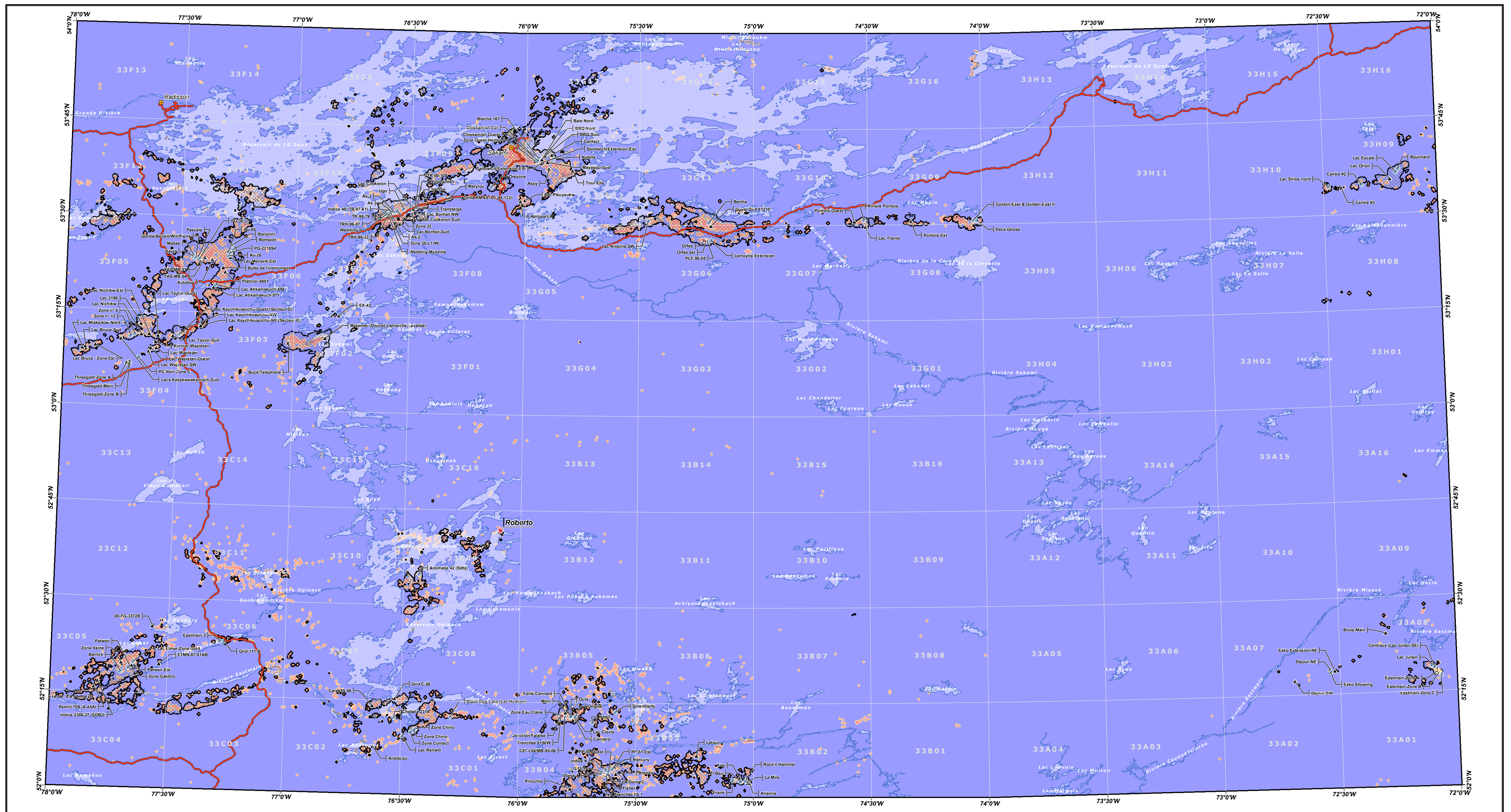
Carte A5.3

Proximité de dykes porphyriques de composition felsique ou intermédiaire

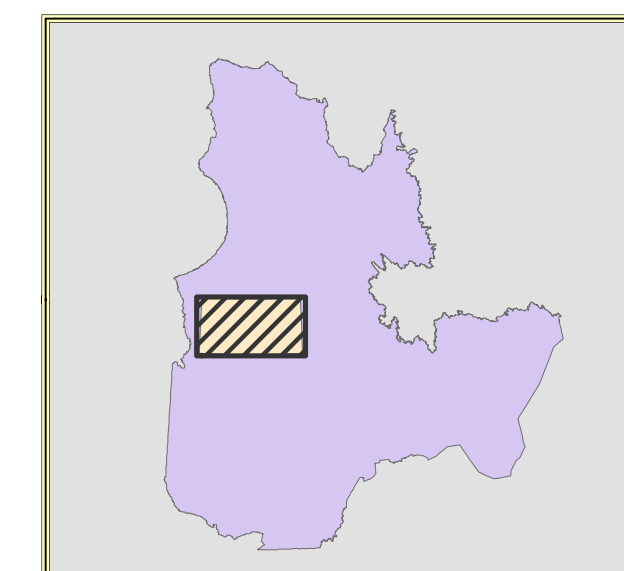


Projection : UTM NAD83, zone 18N
Source : EP 2008-01, MRNFQ

Potentiel en minéralisations de type or orogénique de la Baie-James

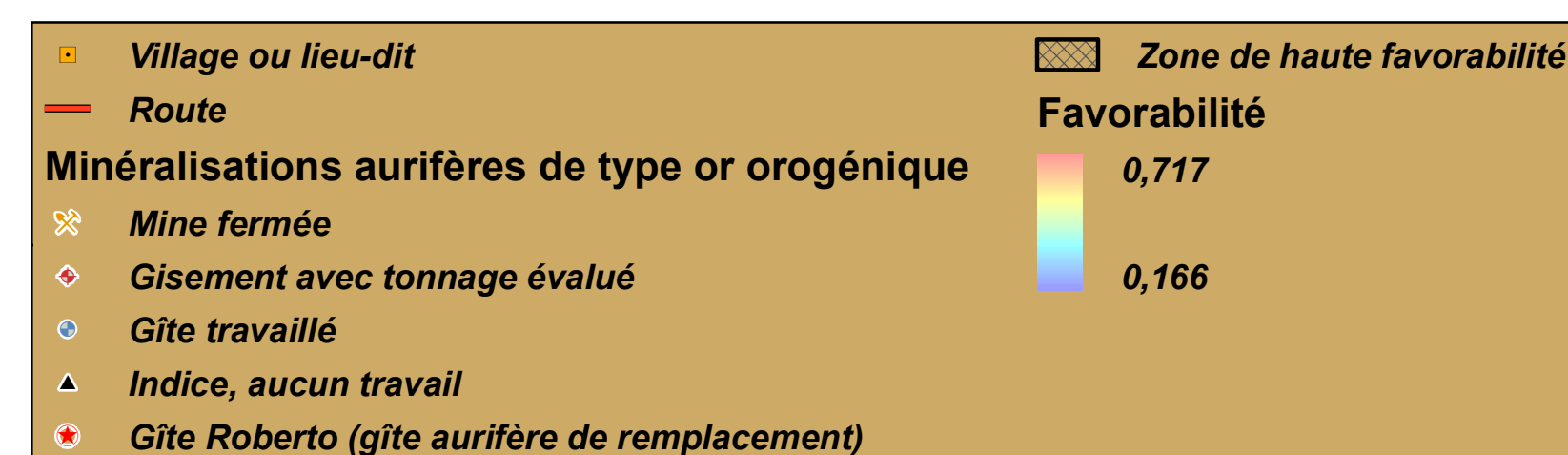
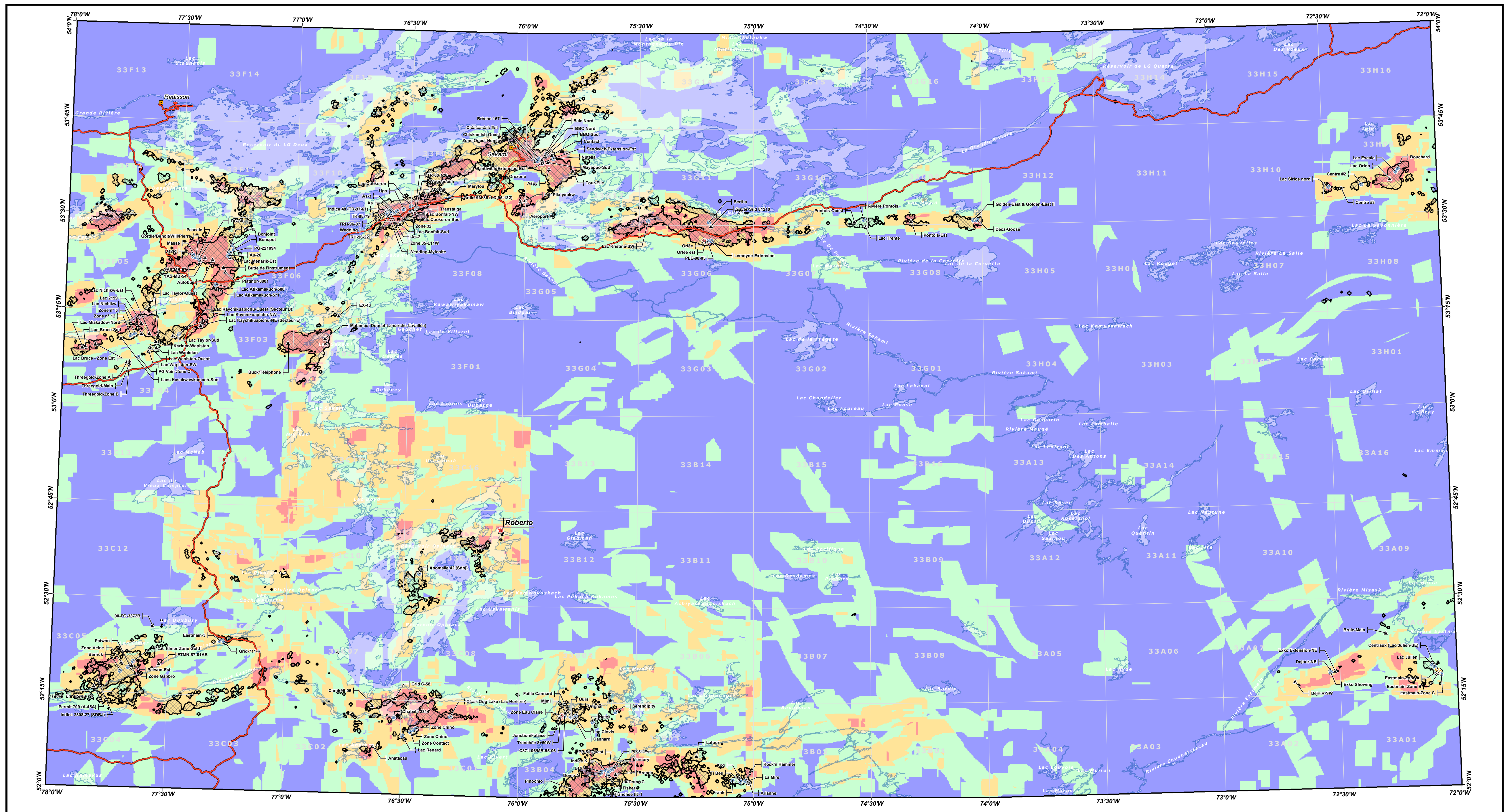


Carte A5.4
Proximité d'une lithologie favorable

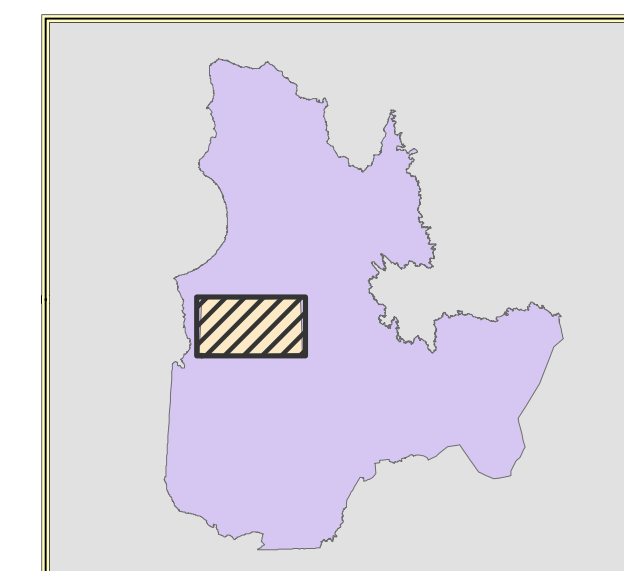


Projection : UTM NAD83, zone 18N
Source : EP 2008-01, MRNFQ

Potentiel en minéralisations de type or orogénique de la Baie-James

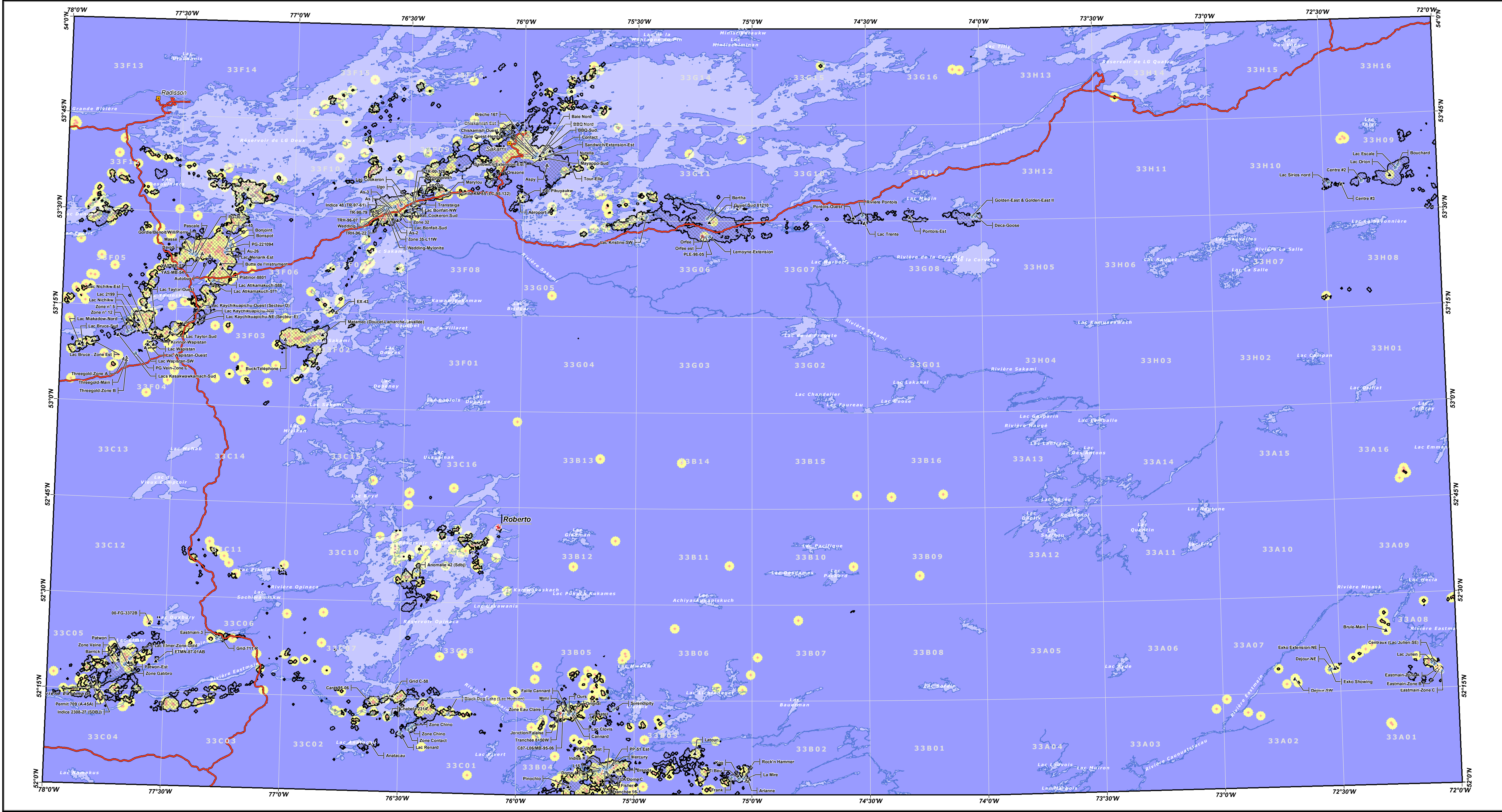


Carte A5.5
Diversité lithologique



Projection : UTM NAD83, zone 18N
Source : EP 2008-01, MRNFQ

Potentiel en minéralisations de type or orogénique de la Baie-James



Village ou lieu-dit

Route

Minéralisations aurifères de type or orogénique

Mine fermée

Gisement avec tonnage évalué

Gîte travaillé

Indice, aucun travail

Gîte Roberto (gîte aurifère de remplacement)

Zone de haute favorabilité

Favorabilité

0,841

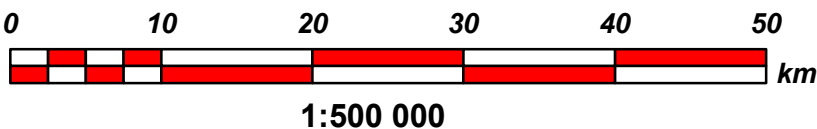
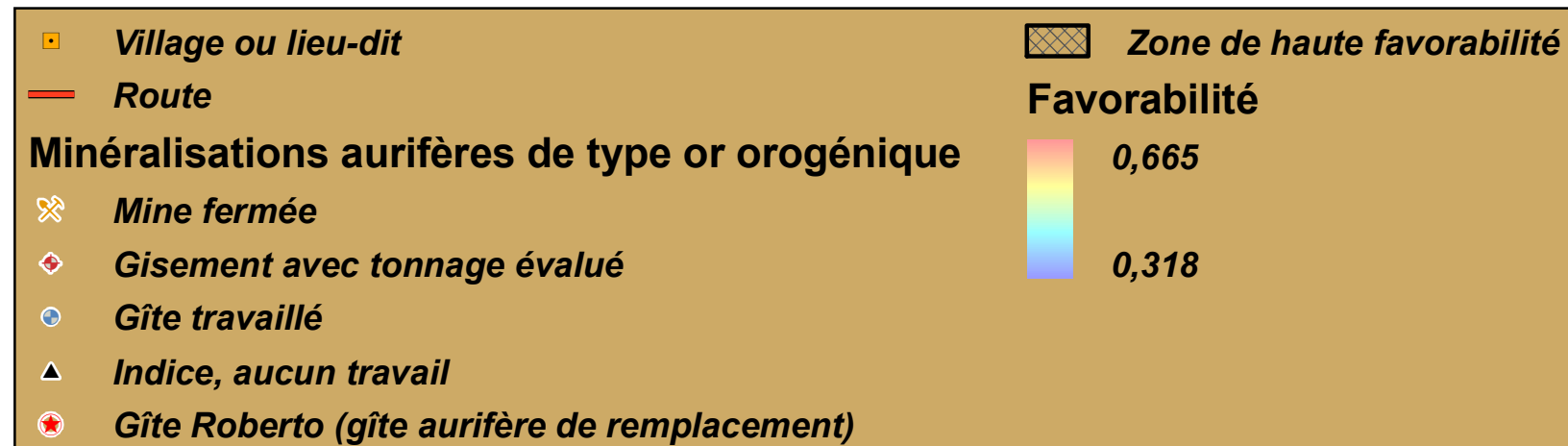
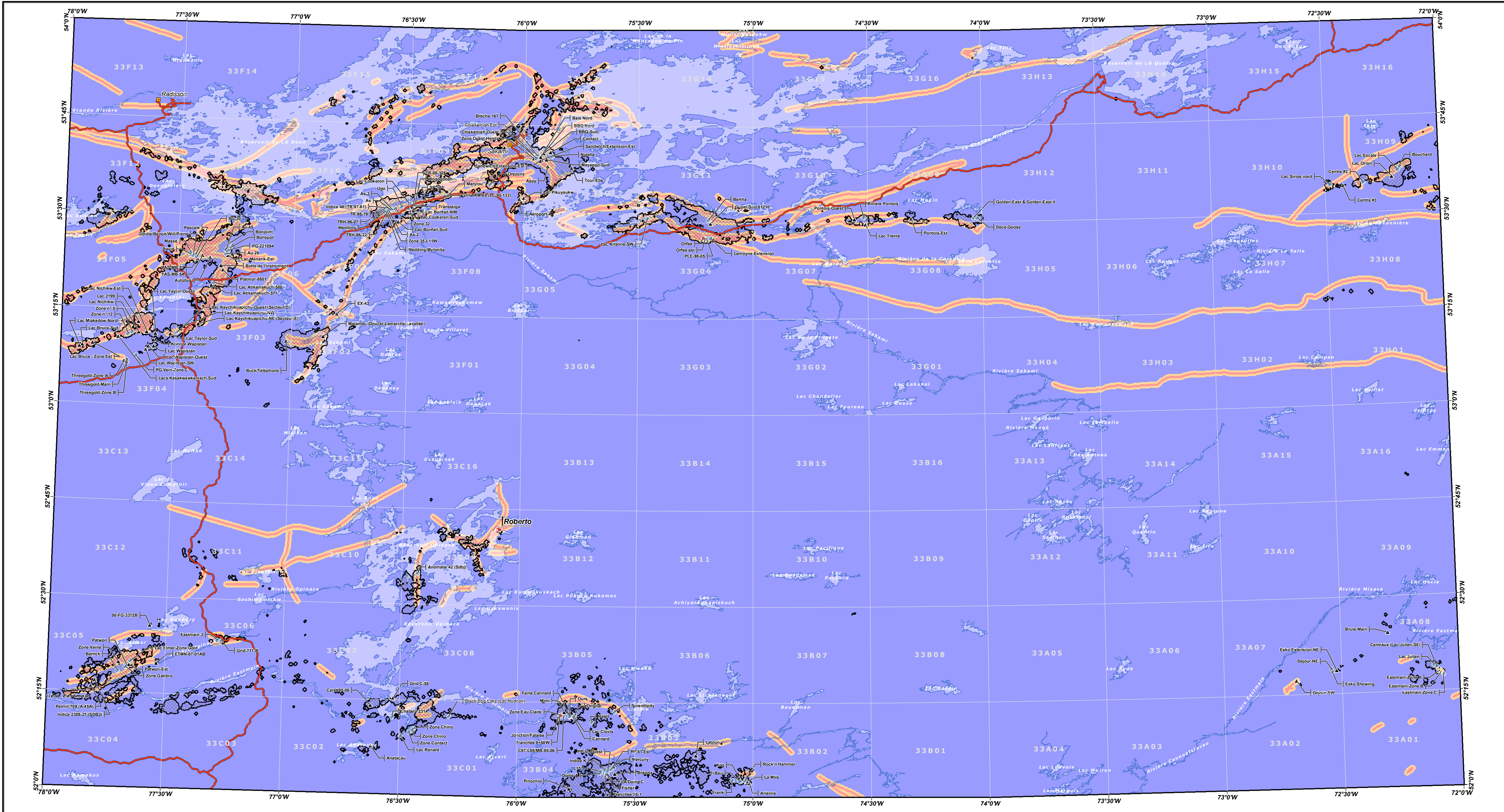
0,203

Carte A5.6
Proximité d'une faille ou d'un cisaillement local

Projection : UTM NAD83, zone 18N
Source : EP 2008-01, MRNFQ

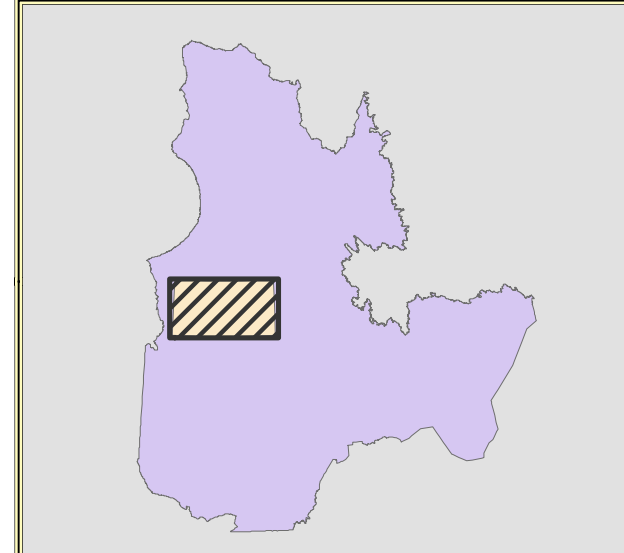
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Potentiel en minéralisations de type or orogénique de la Baie-James



Carte A5.7

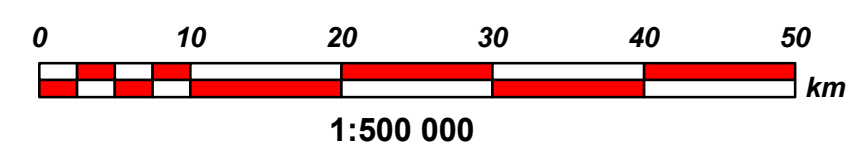
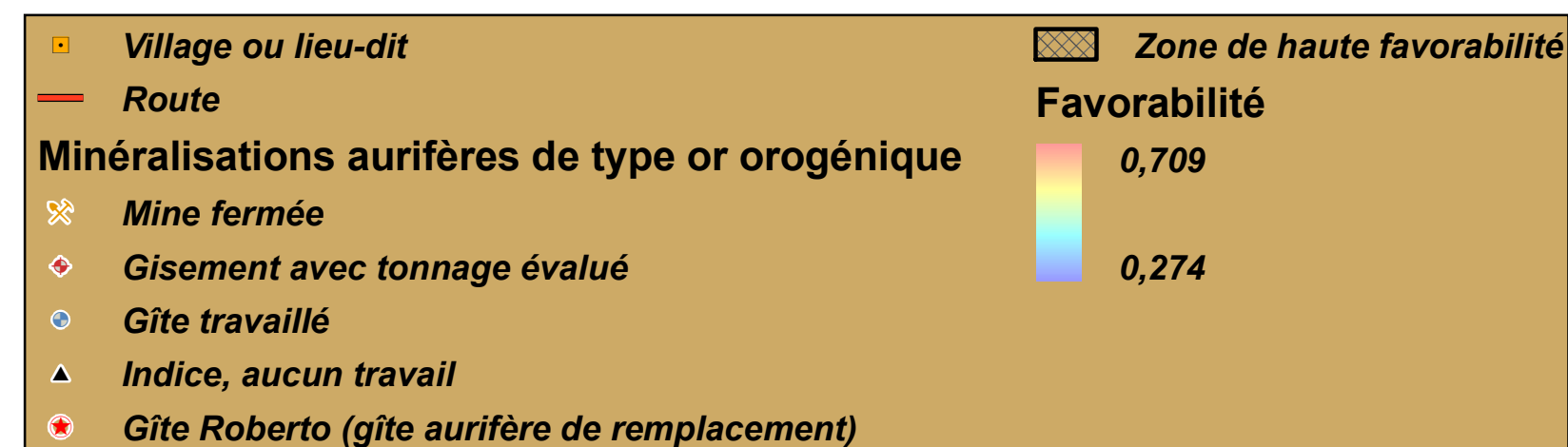
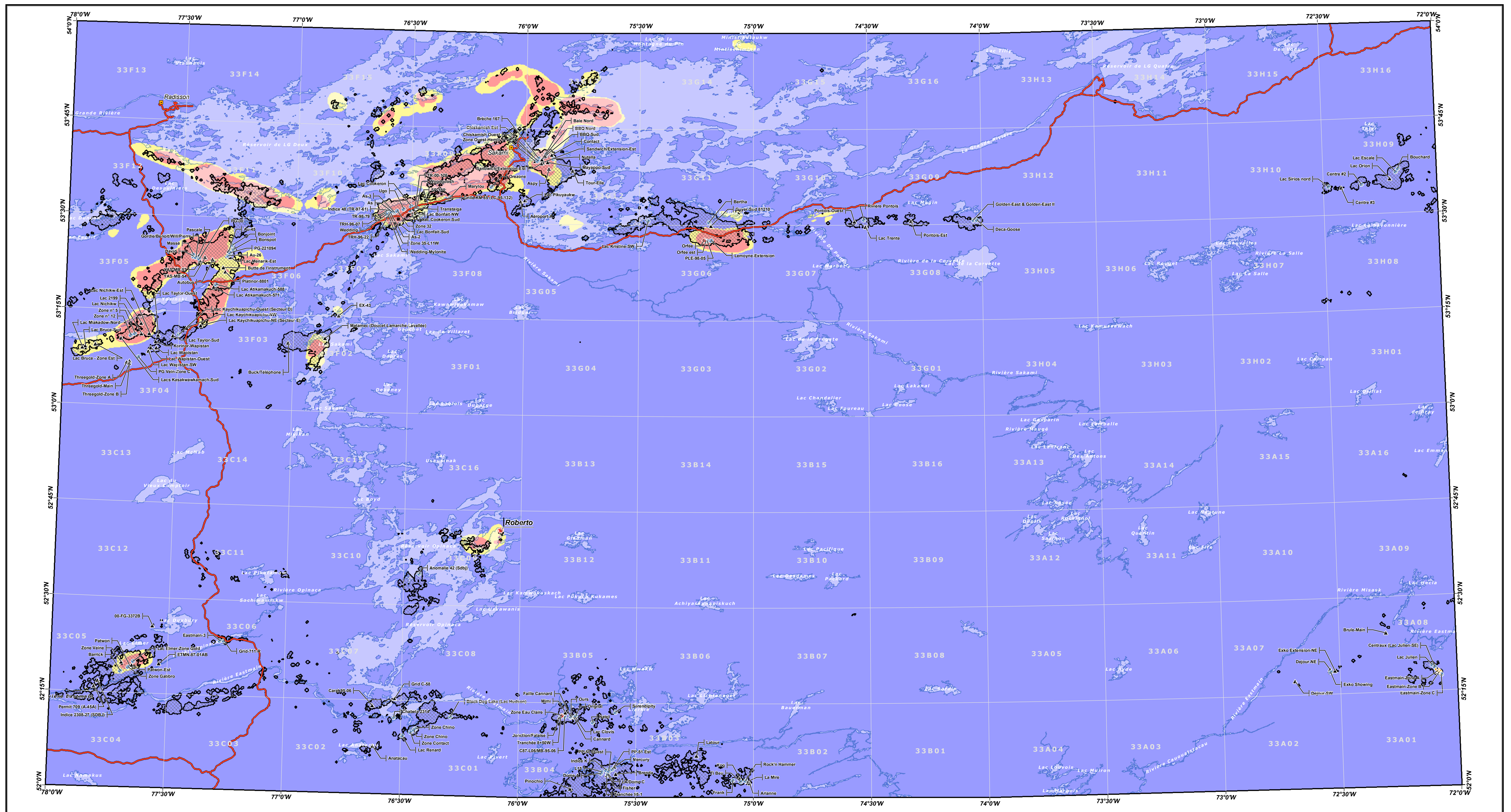
Proximité d'une faille archéenne cartographique



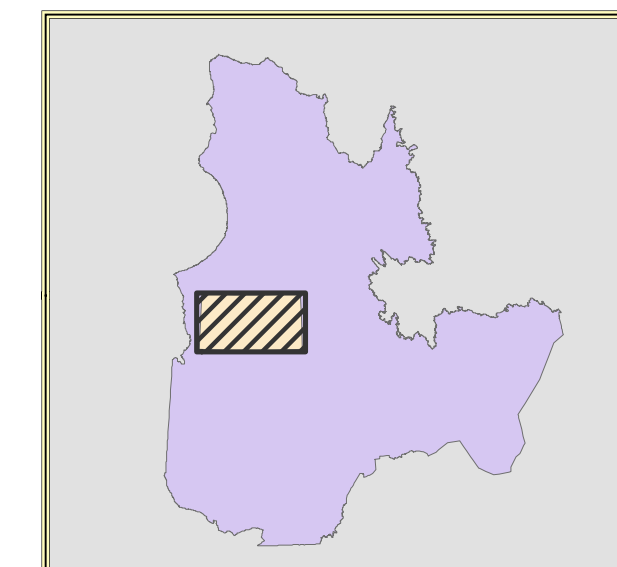
Projection : UTM NAD83, zone 18N
Source : EP 2008-01, MRNFQ

ressources naturelles
Faune
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Potentiel en minéralisations de type or orogénique de la Baie-James

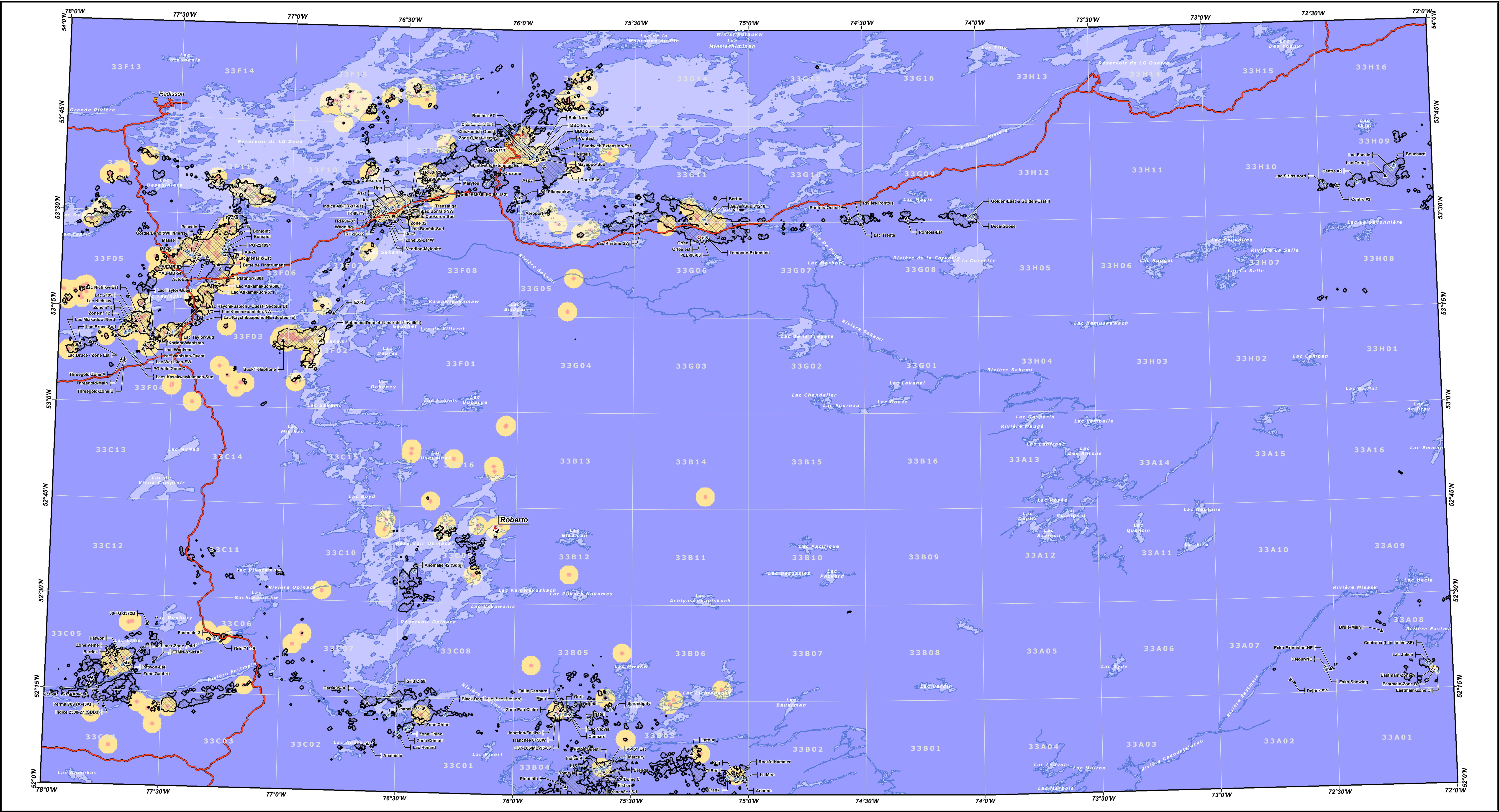


Carte A5.8
Densité de failles archéennes cartographiques



Projection : UTM NAD83, zone 18N
Source : EP 2008-01, MRNFQ

Potentiel en minéralisations de type or orogénique de la Baie-James



Village ou lieu-dit

Route

Minéralisations aurifères de type or orogénique

Mine fermée

Gisement avec tonnage évalué

Gîte travaillé

Indice, aucun travail

Gîte Roberto (gîte aurifère de remplacement)

Zone de haute favorabilité

Favorabilité

0,800

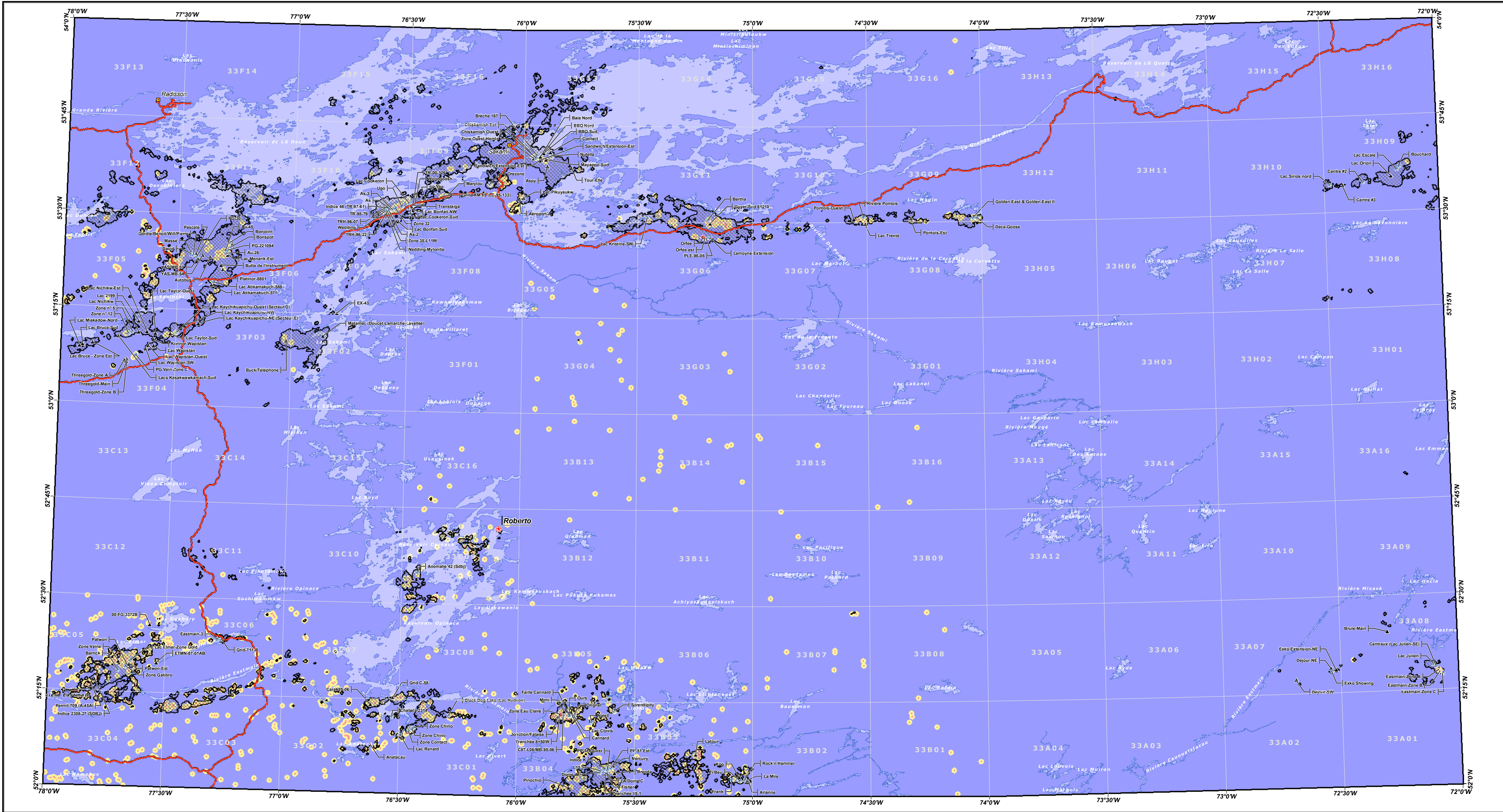
0,239

Carte A5.9
Proximité de charnière de pli local

Projection : UTM NAD83, zone 18N
Source : EP 2008-01, MRNFQ

Resources naturelles
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Québec

Potentiel en minéralisations de type or orogénique de la Baie-James



Village ou lieu-dit

Route

Minéralisations aurifères de type or orogénique

Mine fermée

Gisement avec tonnage évalué

Gîte travaillé

Indice, aucun travail

Gîte Roberto (gîte aurifère de remplacement)

Zone de haute favorabilité

Favorabilité

0,838

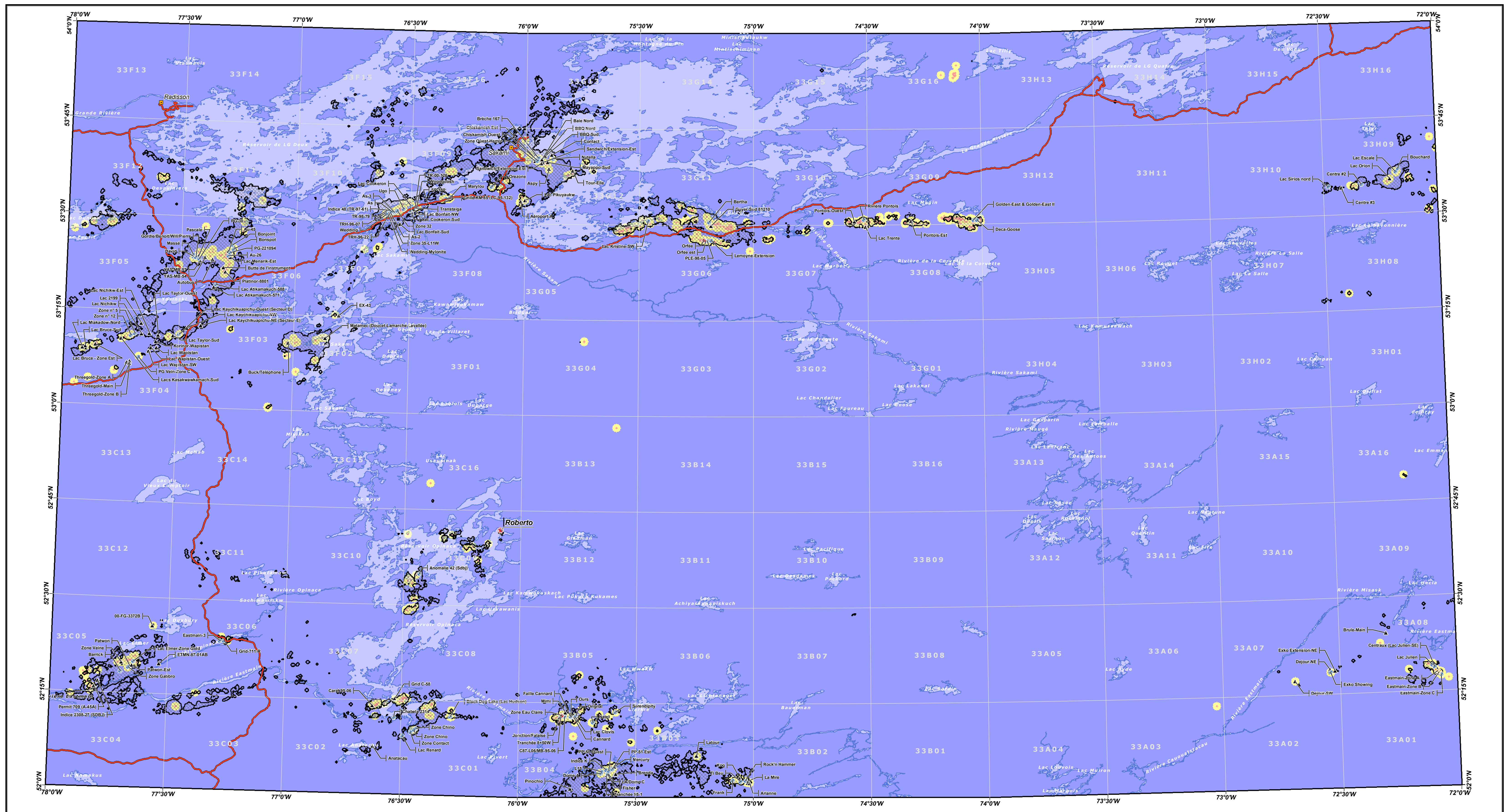
0,190

Carte A5.10
Proximité de veines de quartz

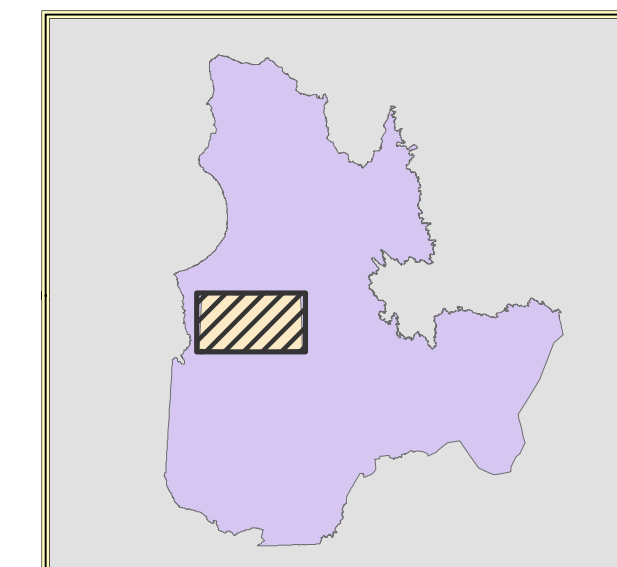
Projection : UTM NAD83, zone 18N
Source : EP 2008-01, MRNFQ

Ressources naturelles
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Potentiel en minéralisations de type or orogénique de la Baie-James



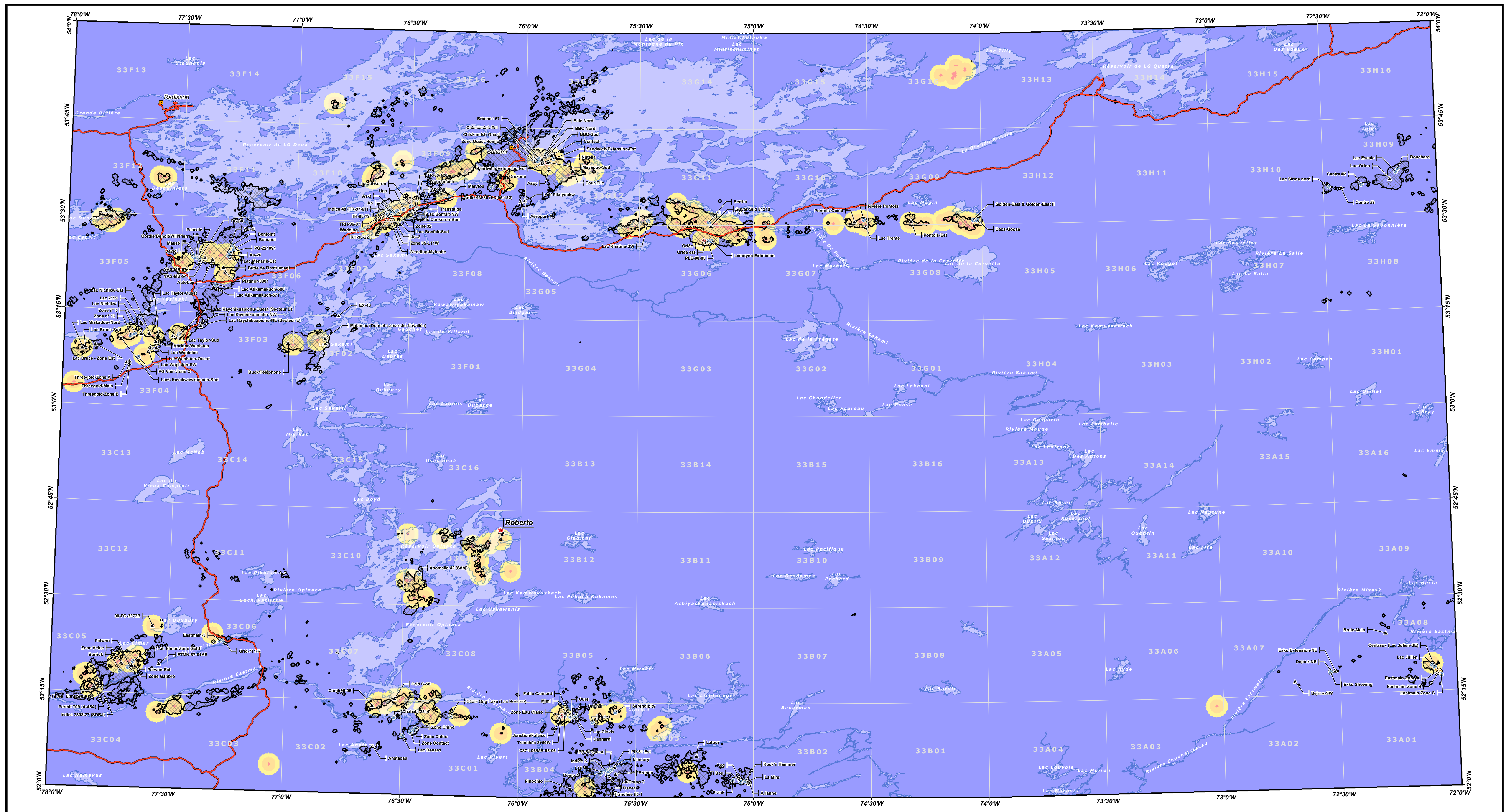
Carte A5.11
Proximité d'une anomalie en Au
dans le substrat rocheux



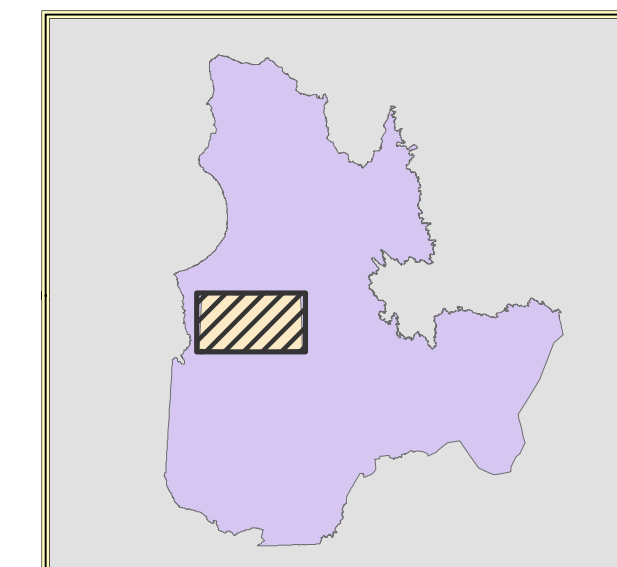
Projection : UTM NAD83, zone 18N
Source : FR 2008.01, MBNEO

ressources naturelles
Faune
Québec

Potentiel en minéralisations de type or orogénique de la Baie-James

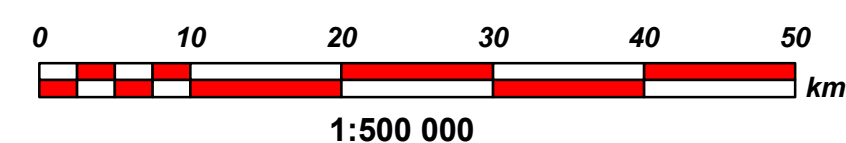
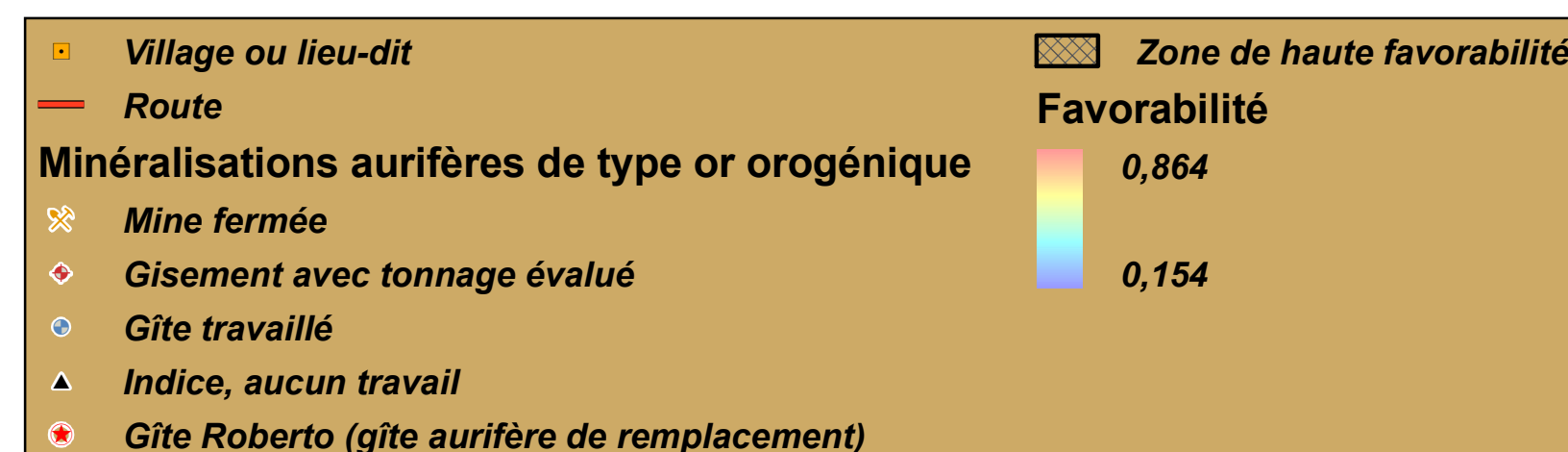
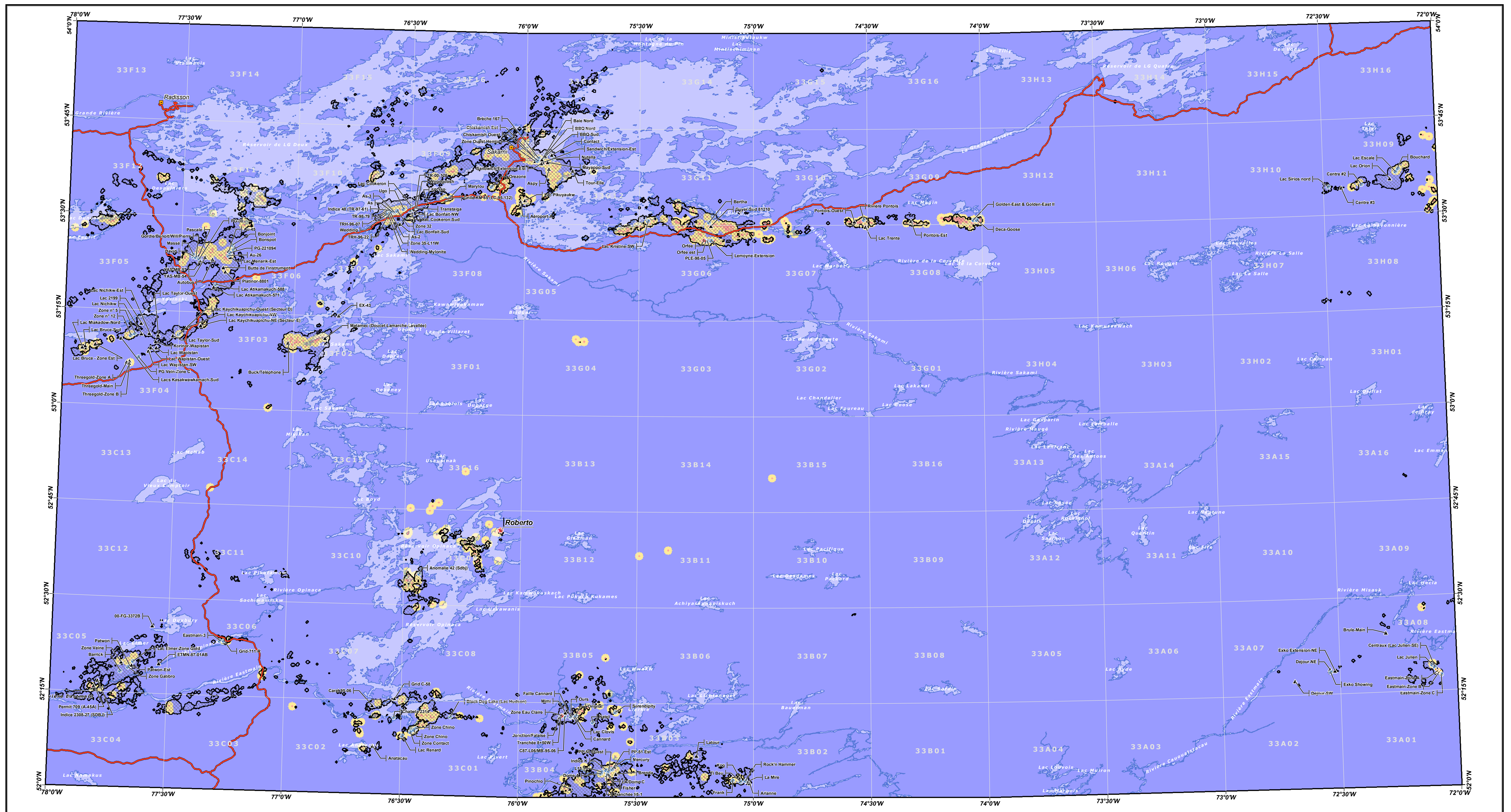


Carte A5.12
Proximité d'une anomalie en Ag
dans le substrat rocheux

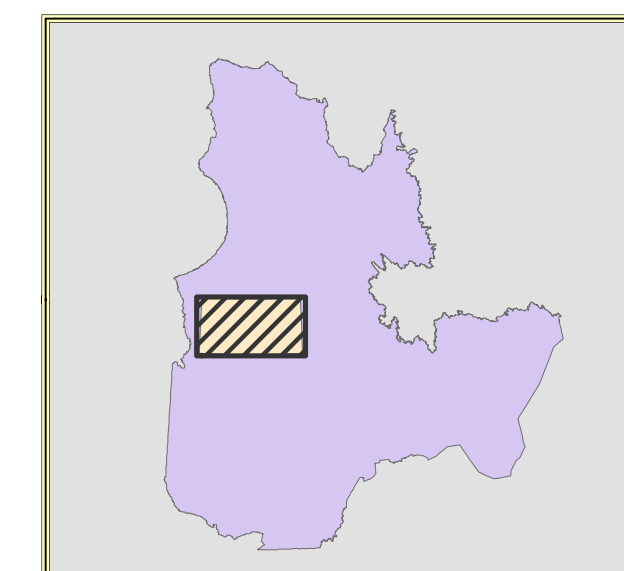


Projection : UTM NAD83, zone 18N
Source : EP 2008-01, MRNFQ

Potentiel en minéralisations de type or orogénique de la Baie-James



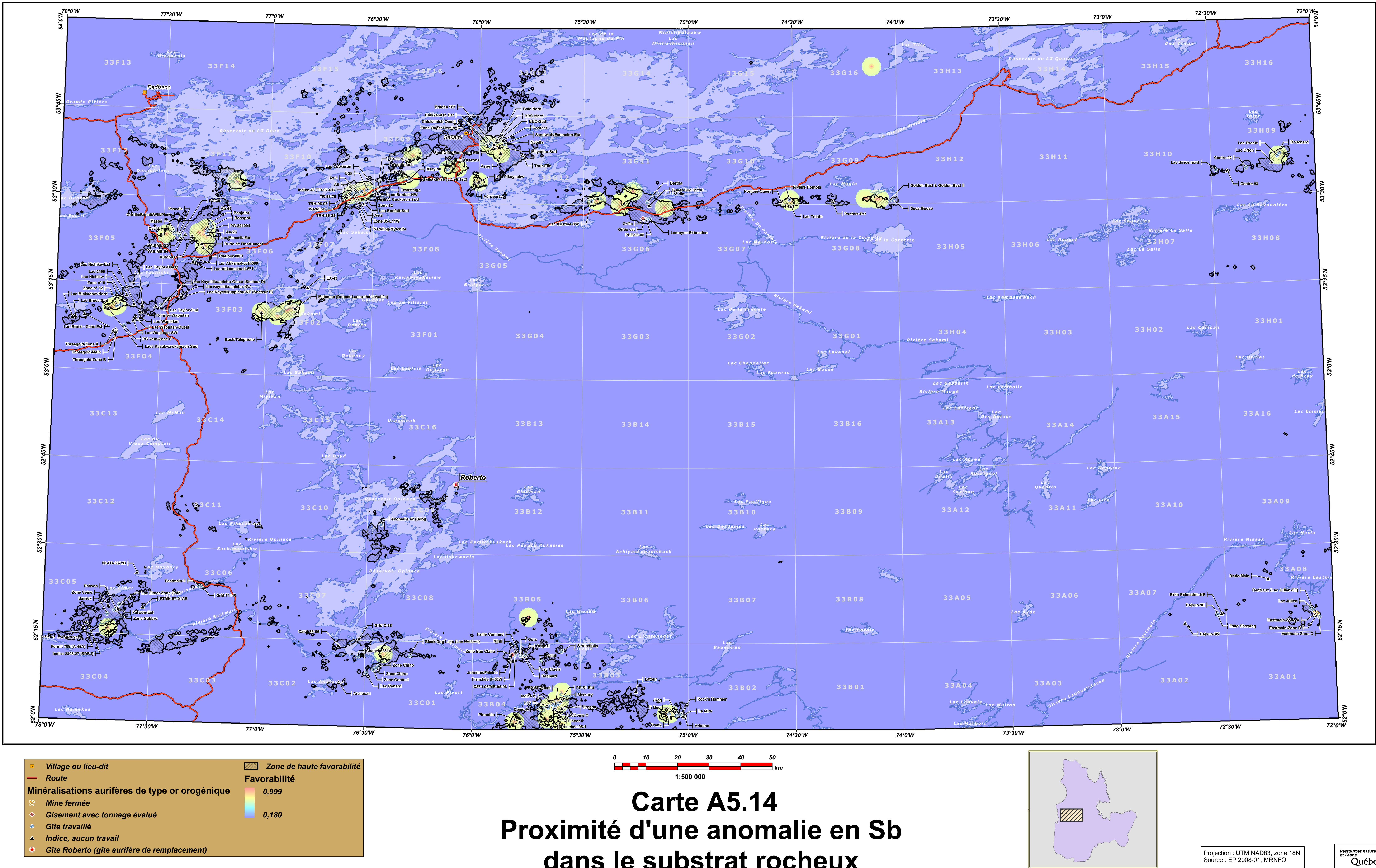
Carte A5.13
Proximité d'une anomalie en As
dans le substrat rocheux



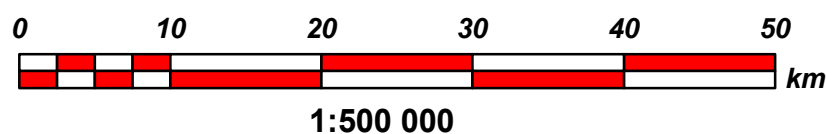
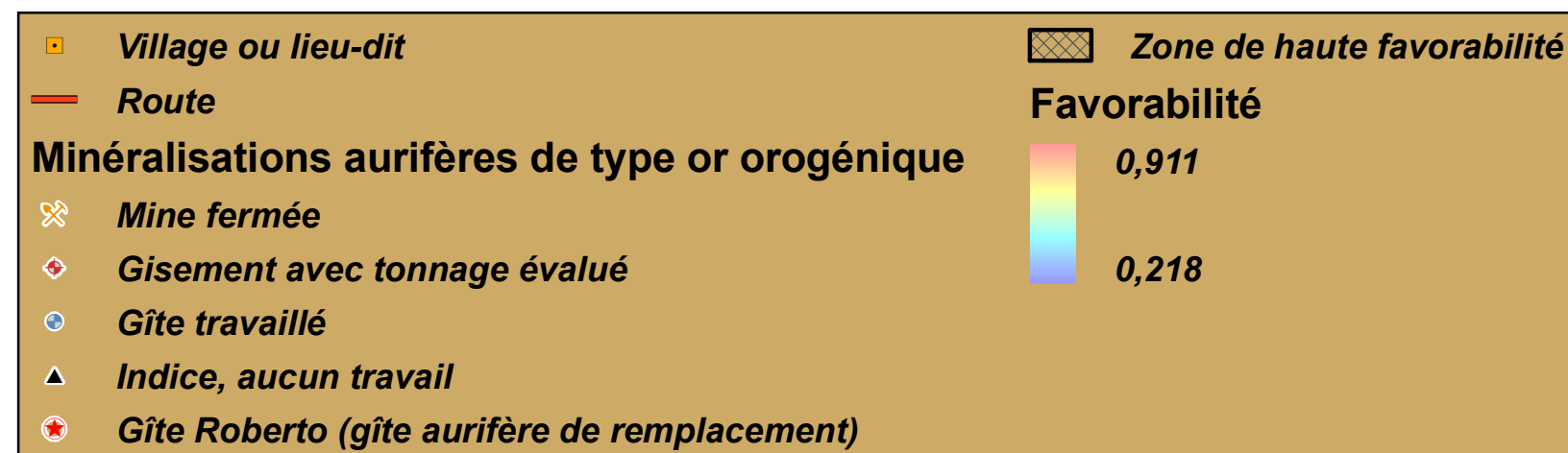
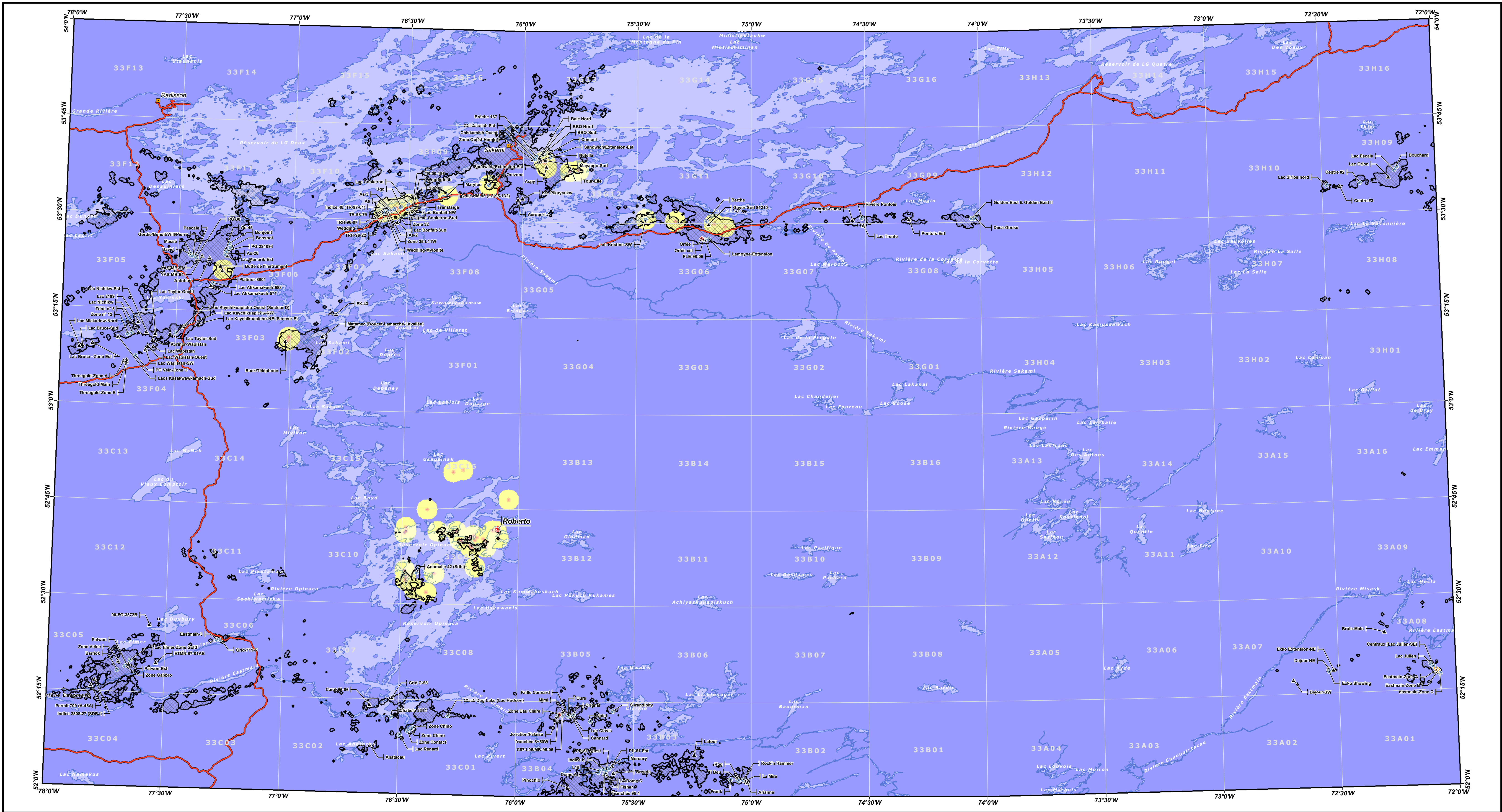
Projection : UTM NAD83, zone 18N
Source : EP 2008-01, MRNFQ

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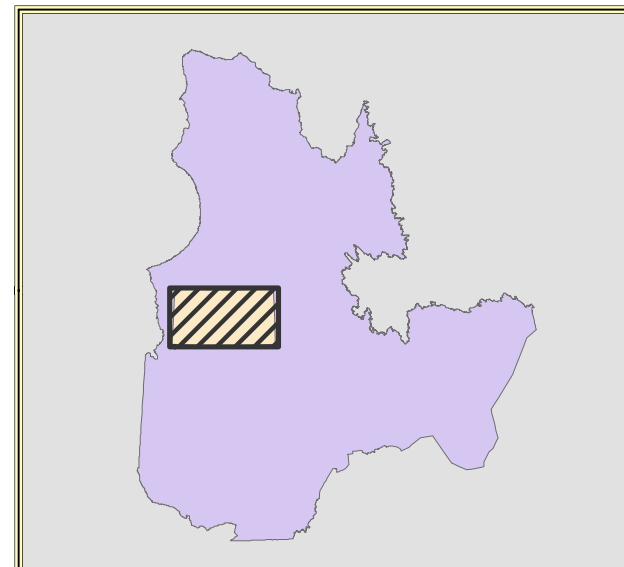
Potentiel en minéralisations de type or orogénique de la Baie-James



Potentiel en minéralisations de type or orogénique de la Baie-James

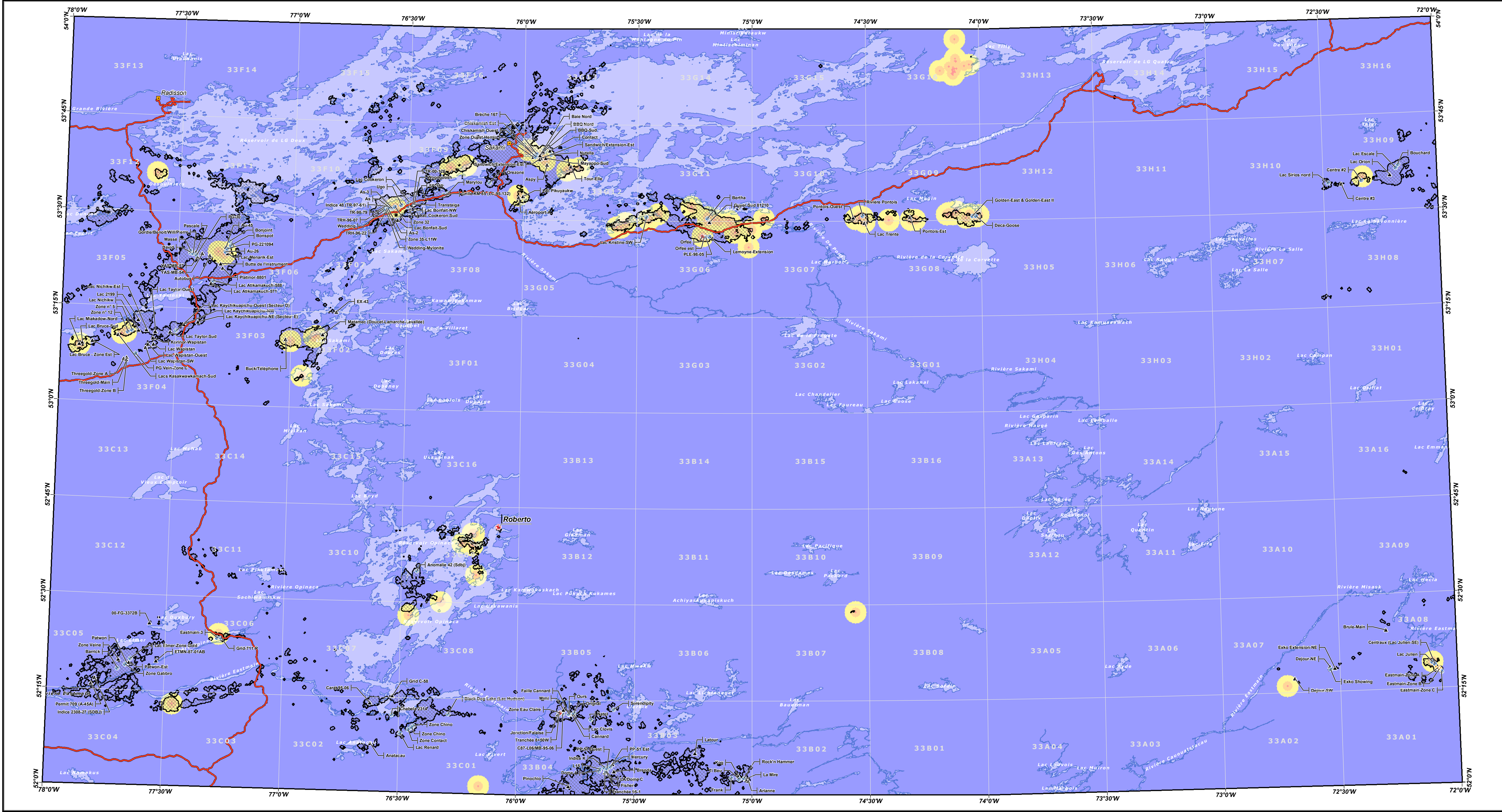


Carte A5.15
Proximité d'une anomalie en B
dans le substrat rocheux



Projection : UTM NAD83, zone 18N

Potentiel en minéralisations de type or orogénique de la Baie-James



Village ou lieu-dit

Route

Minéralisations aurifères de type or orogénique

Mine fermée

Gisement avec tonnage évalué

Gîte travaillé

Indice, aucun travail

Gîte Roberto (gîte aurifère de remplacement)

Zone de haute favorabilité

Favorabilité

0,853

0,229

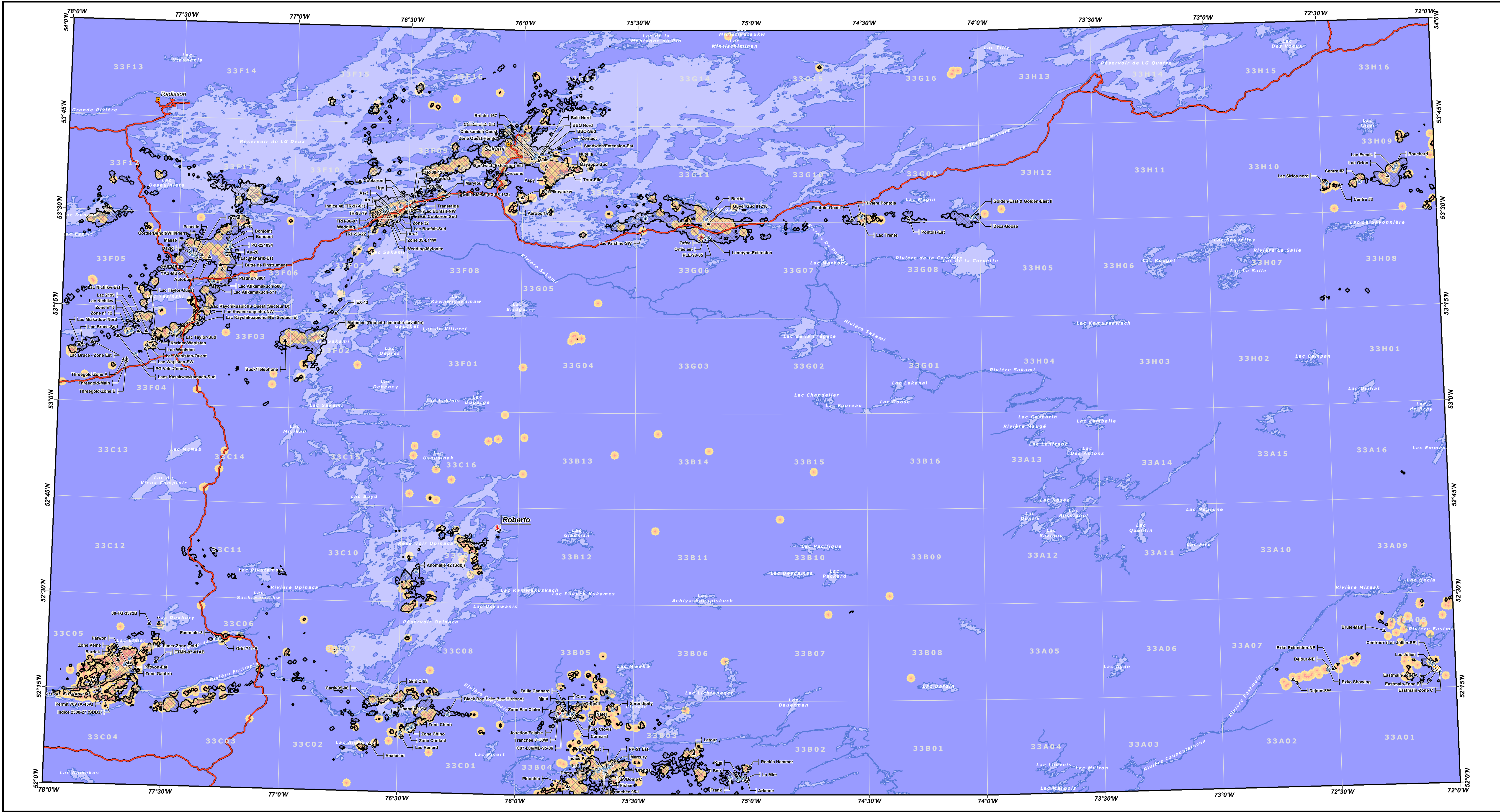
1:500 000

Carte A5.16
Proximité d'une anomalie en Mo
dans le substrat rocheux

Projection : UTM NAD83, zone 18N
Source : EP 2008-01, MRNFQ

Ressources naturelles
et Faune
Québec

Potentiel en minéralisations de type or orogénique de la Baie-James



Village ou lieu-dit

Route

Minéralisations aurifères de type or orogénique

Mine fermée

Gisement avec tonnage évalué

Gîte travaillé

Indice, aucun travail

Gîte Roberto (gîte aurifère de remplacement)

Zone de haute favorabilité

Favorabilité

0,809

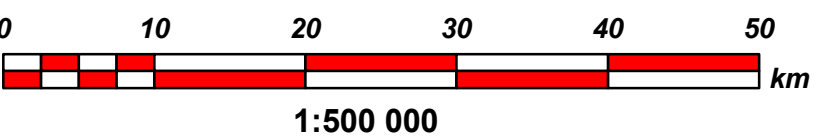
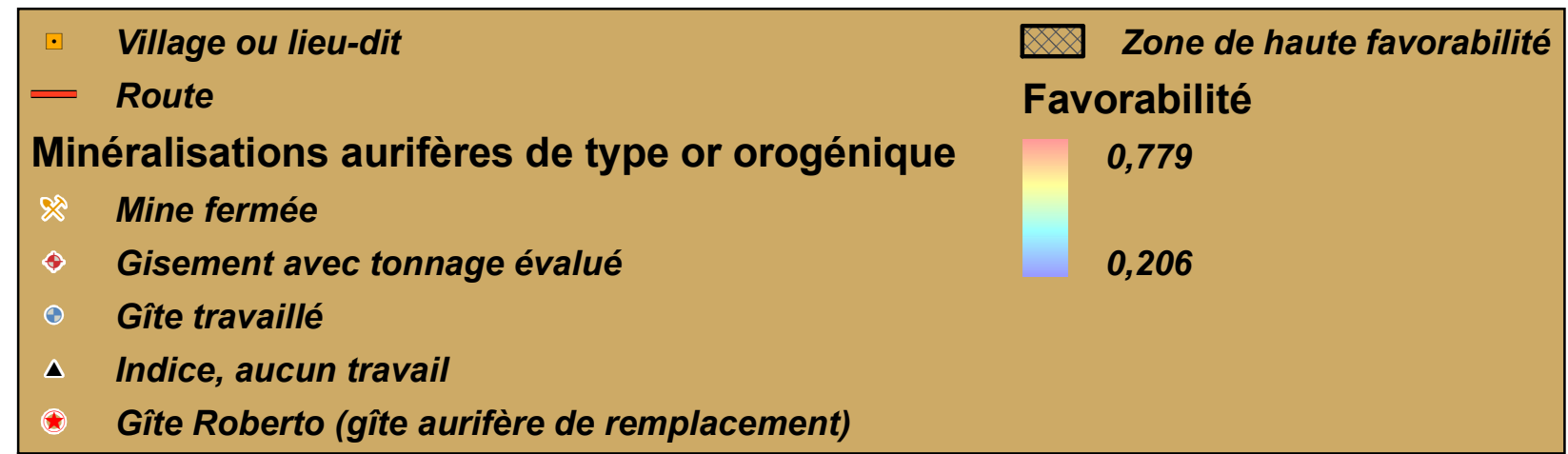
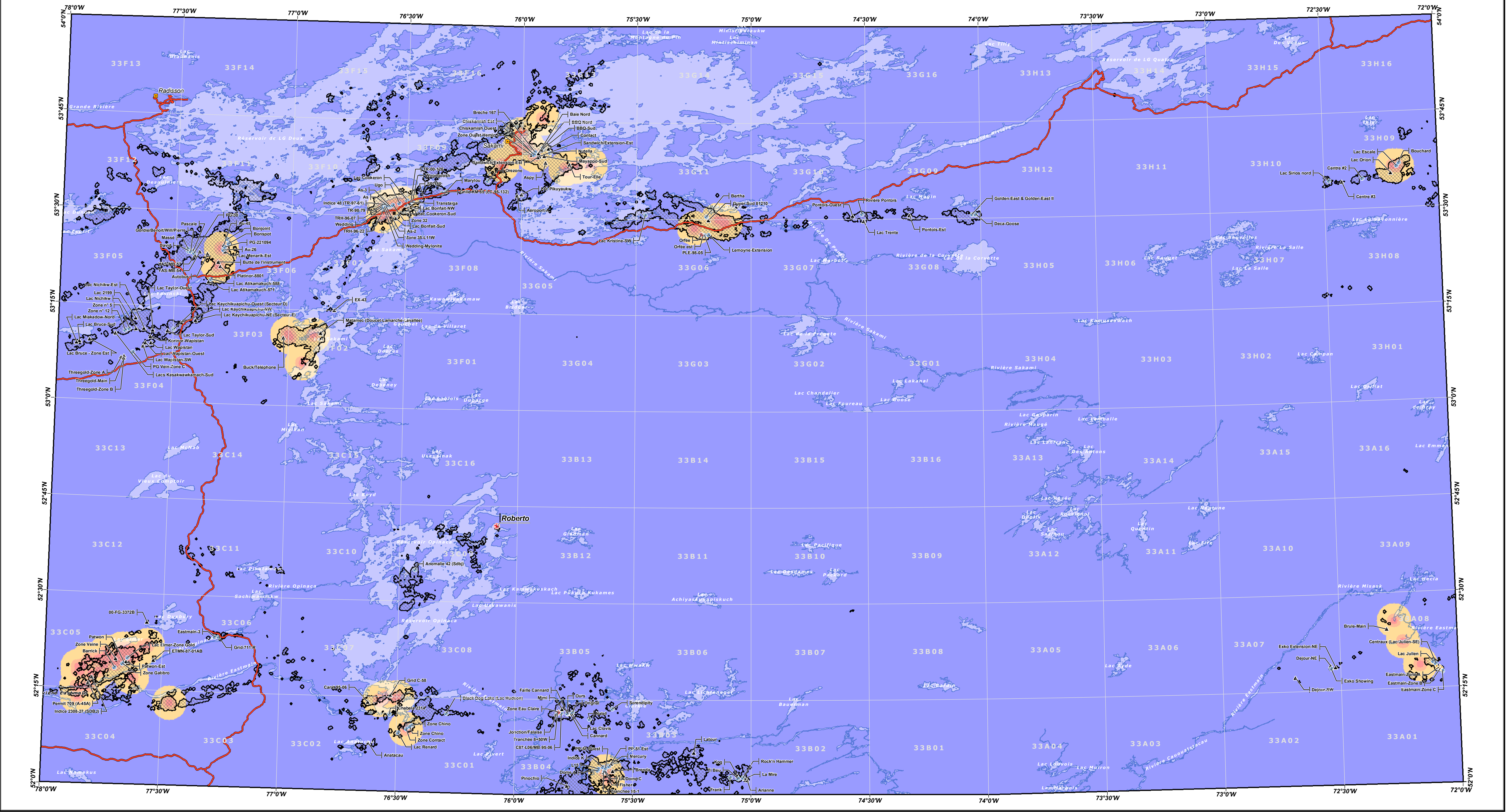
0,170

Carte A5.17
Proximité d'un indice lithochimique d'altération

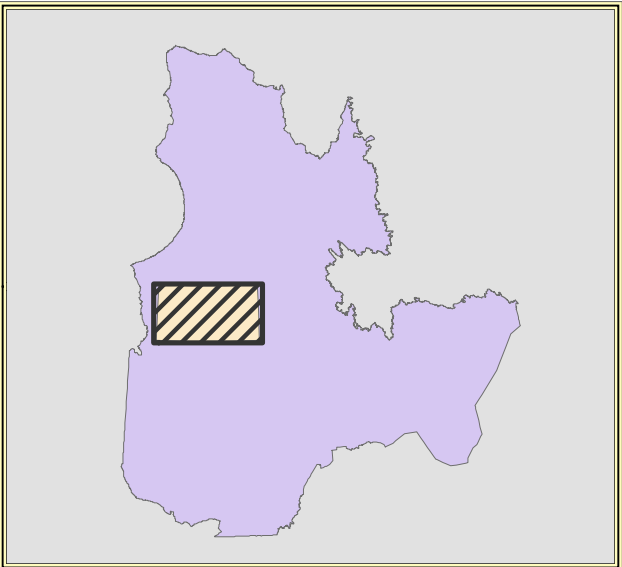
Projection : UTM NAD83, zone 18N
Source : EP 2008-01, MRNFQ

Ressources naturelles
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Potentiel en minéralisations de type or orogénique de la Baie-James



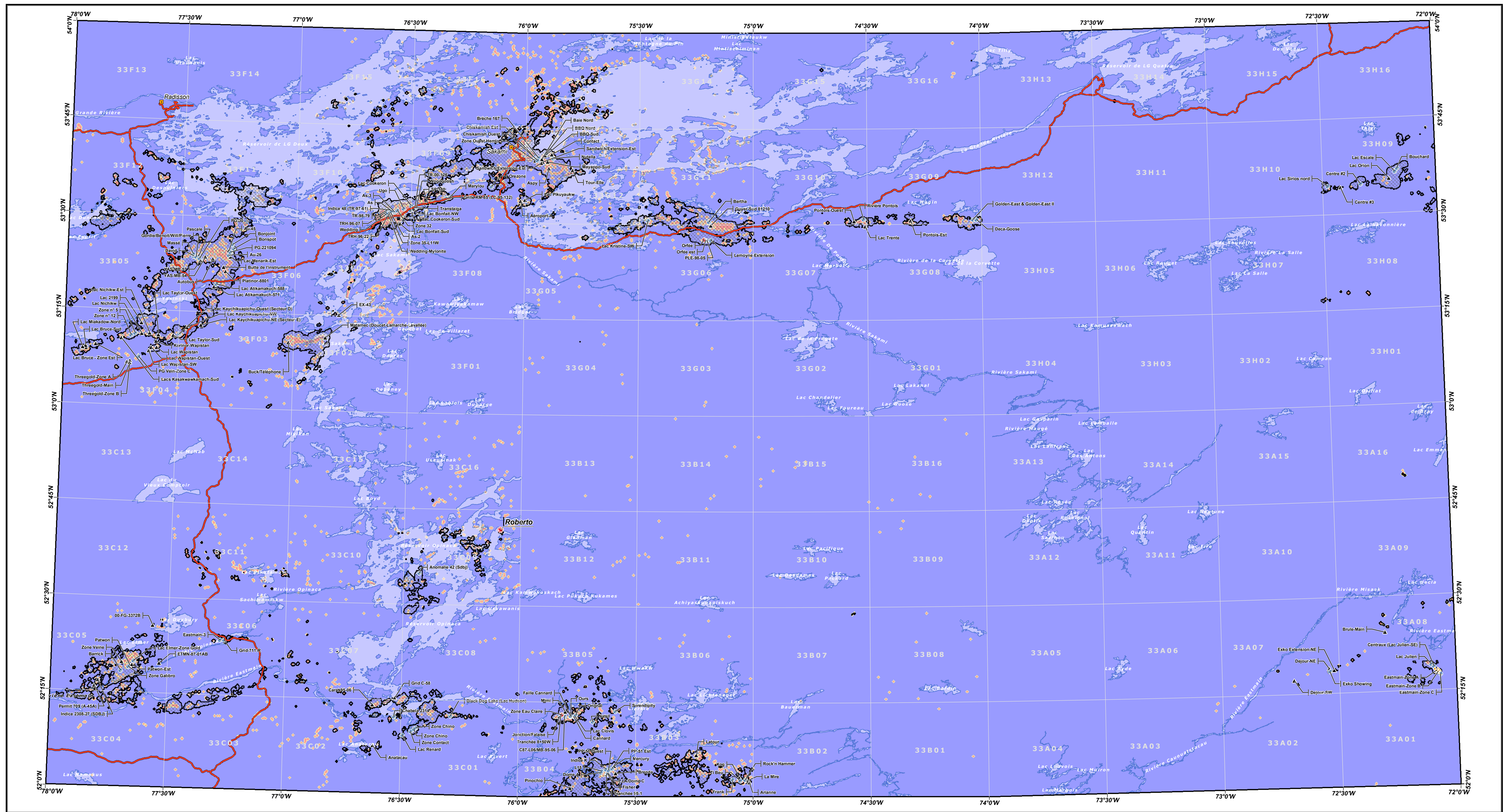
Carte A5.18
Proximité d'un indice ISER anormalique



Projection : UTM NAD83, zone 18N
Source : EP 2008-01, MRNFQ

Ressources naturelles
et Faune
Québec

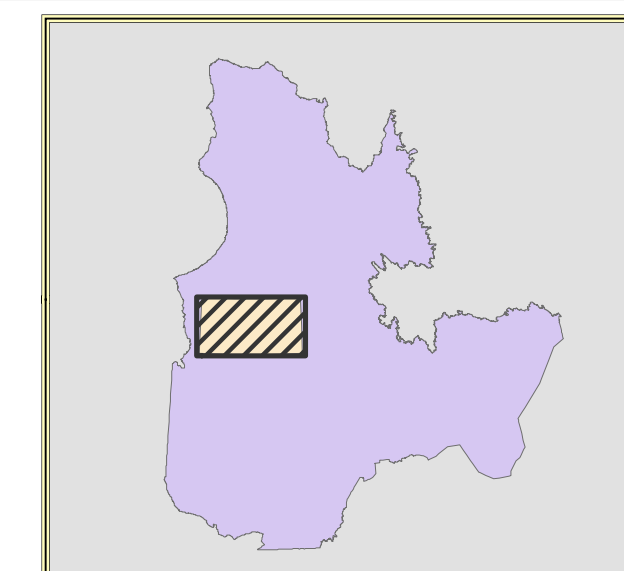
Potentiel en minéralisations de type or orogénique de la Baie-James



0 10 20 30 40 50
1:500 000 km

Carte A5.19

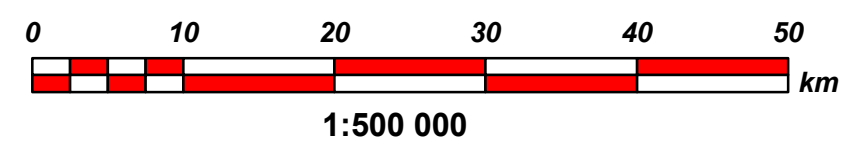
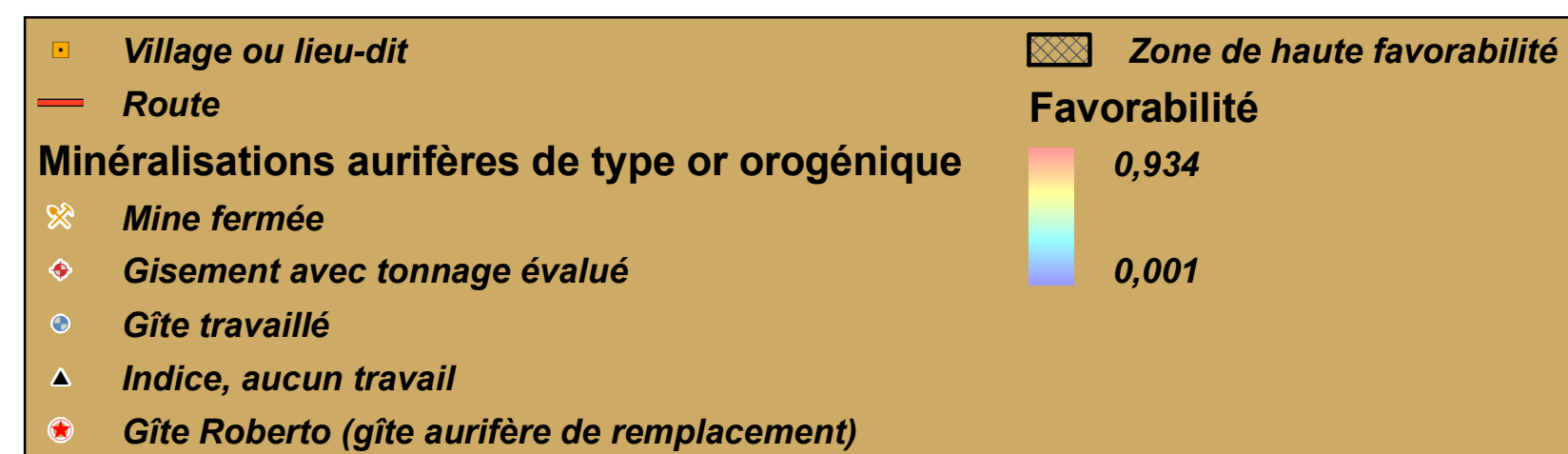
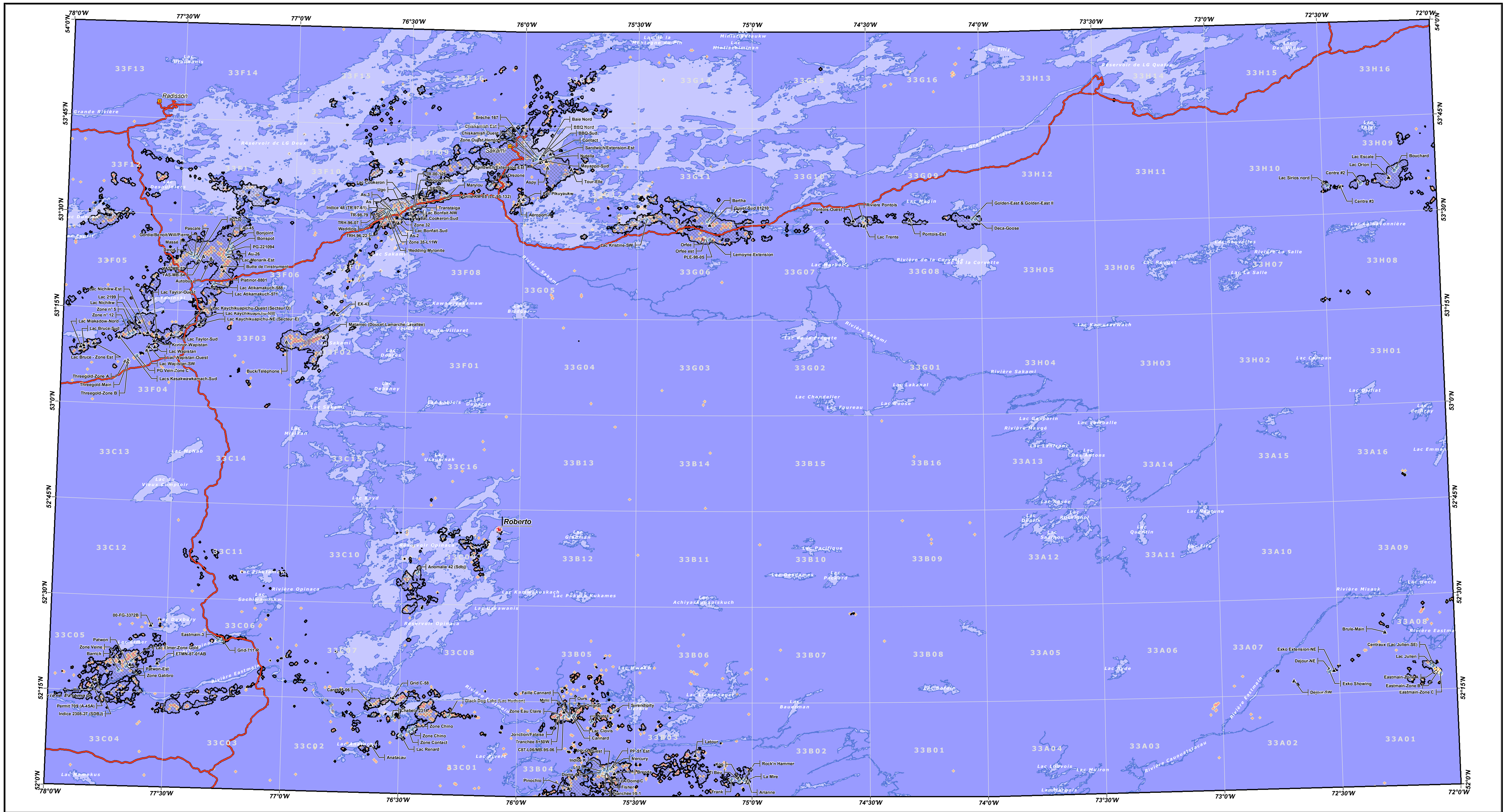
Proximité d'un minéral indicateur d'altération



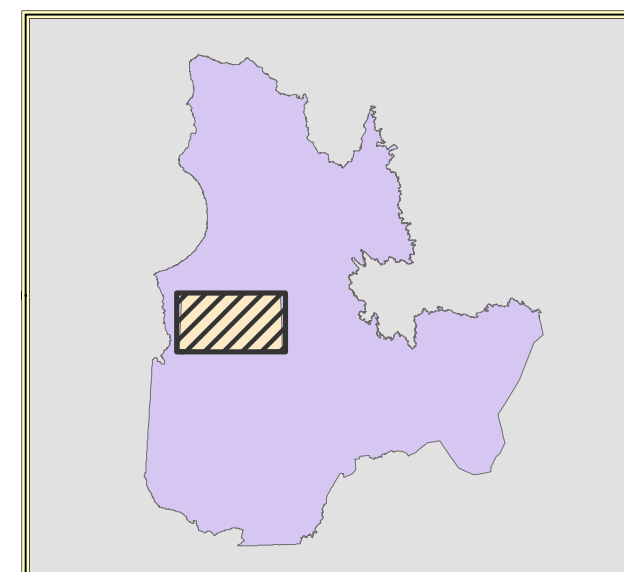
Projection : UTM NAD83, zone 18N
Source : EP 2008-01, MRNFQ

Ressources naturelles
et Faune
Québec

Potentiel en minéralisations de type or orogénique de la Baie-James

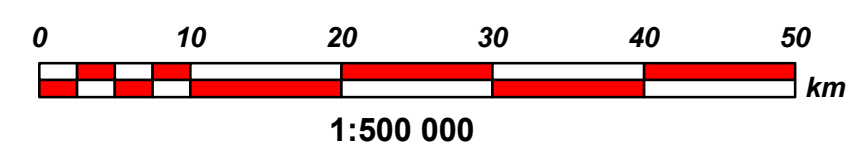
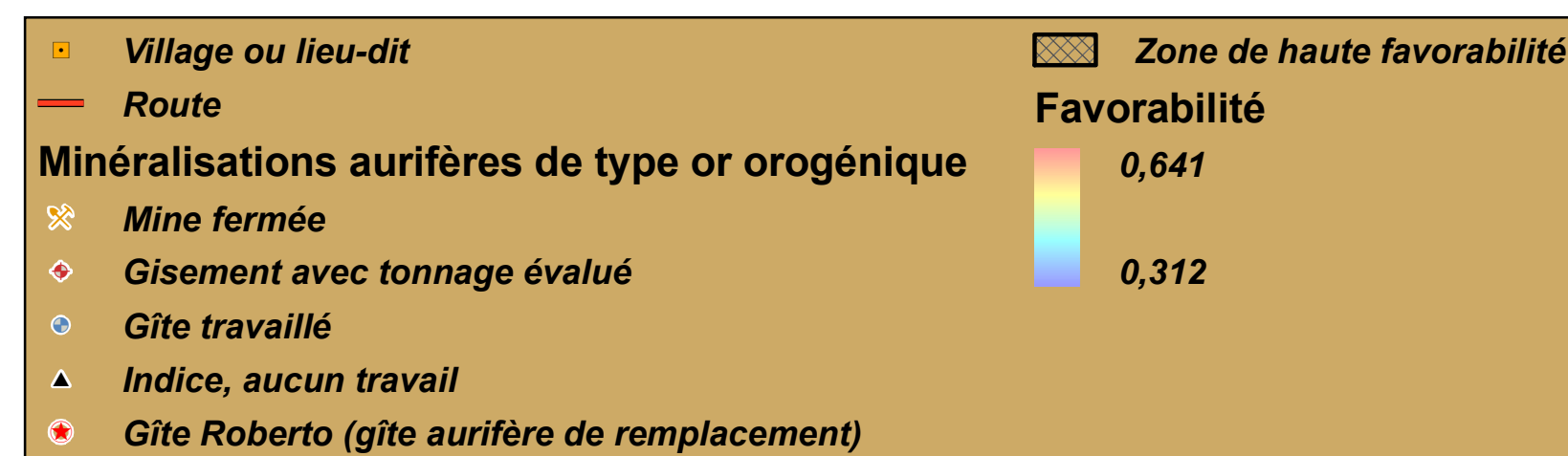
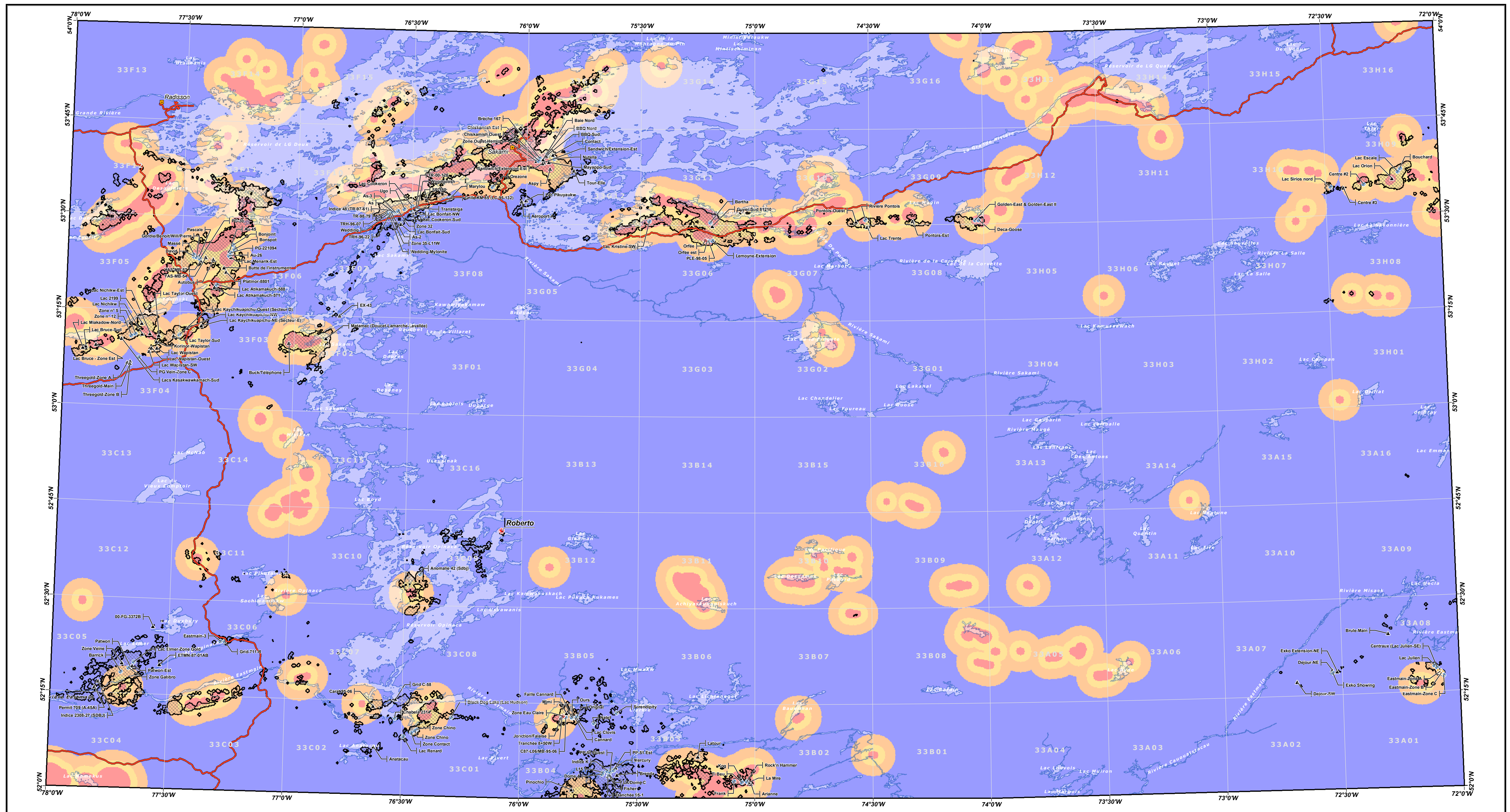


Carte A5.20
Proximité d'un minéral indicateur de minéralisation



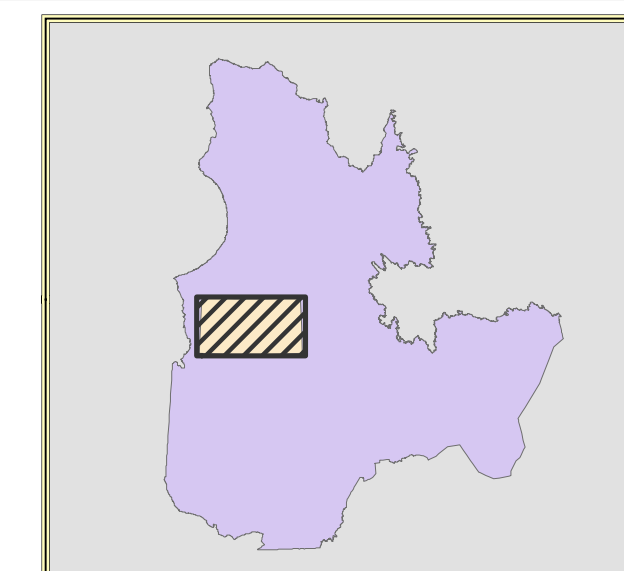
Projection : UTM NAD83, zone 18N
Source : EP 2008-01, MRNFQ

Potentiel en minéralisations de type or orogénique de la Baie-James



Carte A5.21

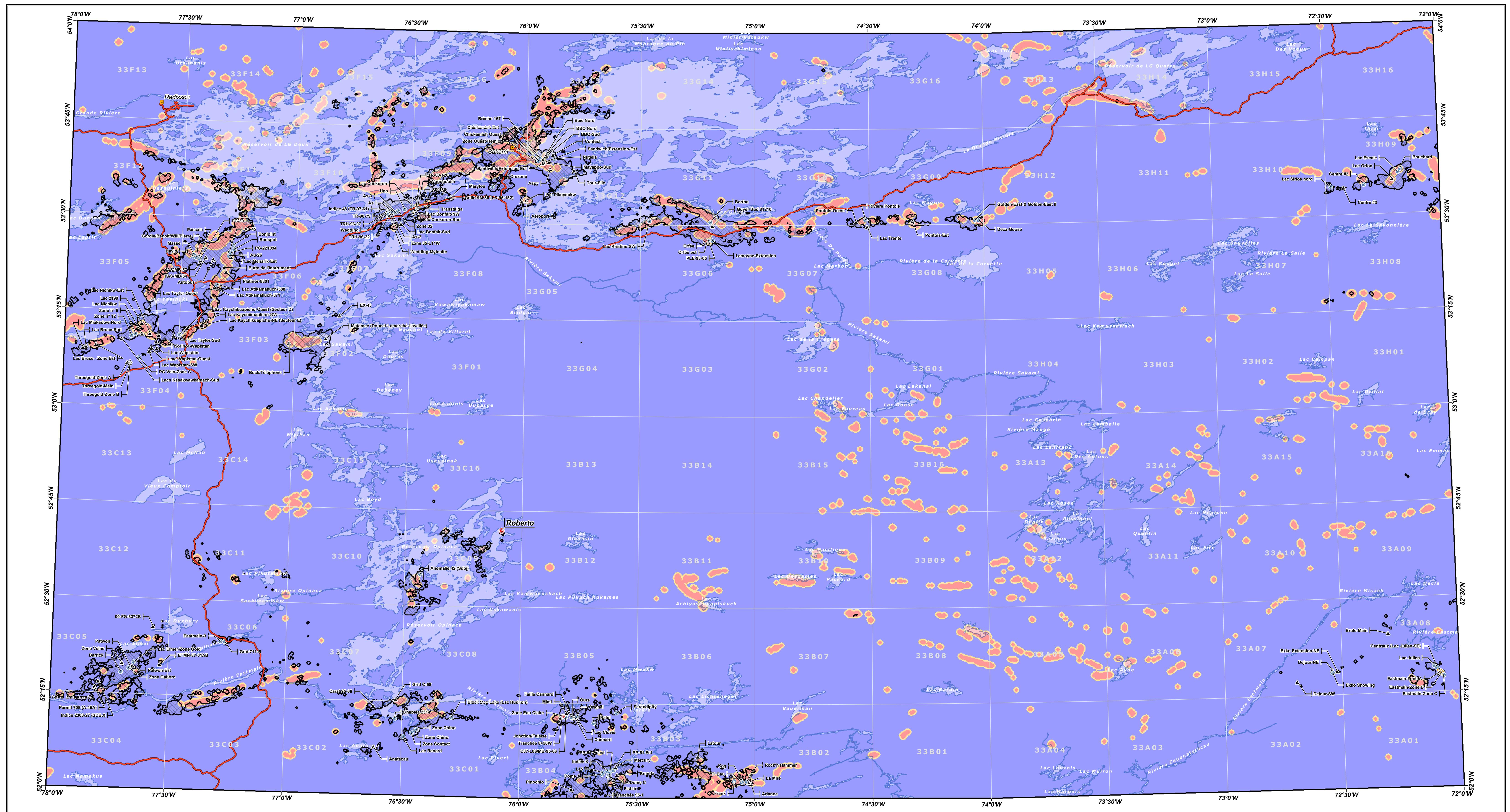
Proximité de valeurs favorables du
champ magnétique résiduel



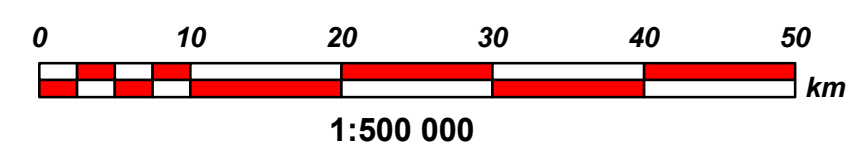
Projection : UTM NAD83, zone 18N
Source : EP 2008-01, MRNFQ

Ressources naturelles
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Potentiel en minéralisations de type or orogénique de la Baie-James

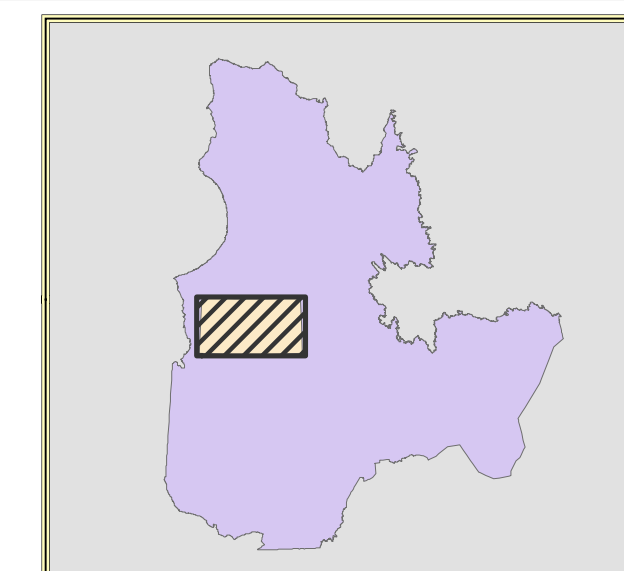


- Village ou lieu-dit
- Route
- Minéralisations aurifères de type or orogénique
- Mine fermée
- Gisement avec tonnage évalué
- Gîte travaillé
- Indice, aucun travail
- Gîte Roberto (gîte aurifère de remplacement)
- Zone de haute favorabilité
- Favorabilité
- 0,647
- 0,337



1:500 000

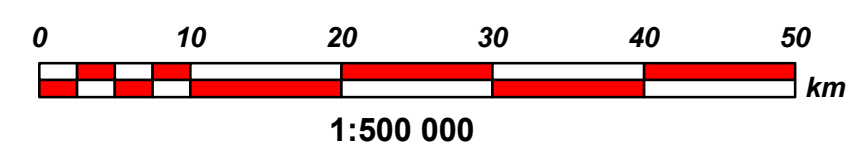
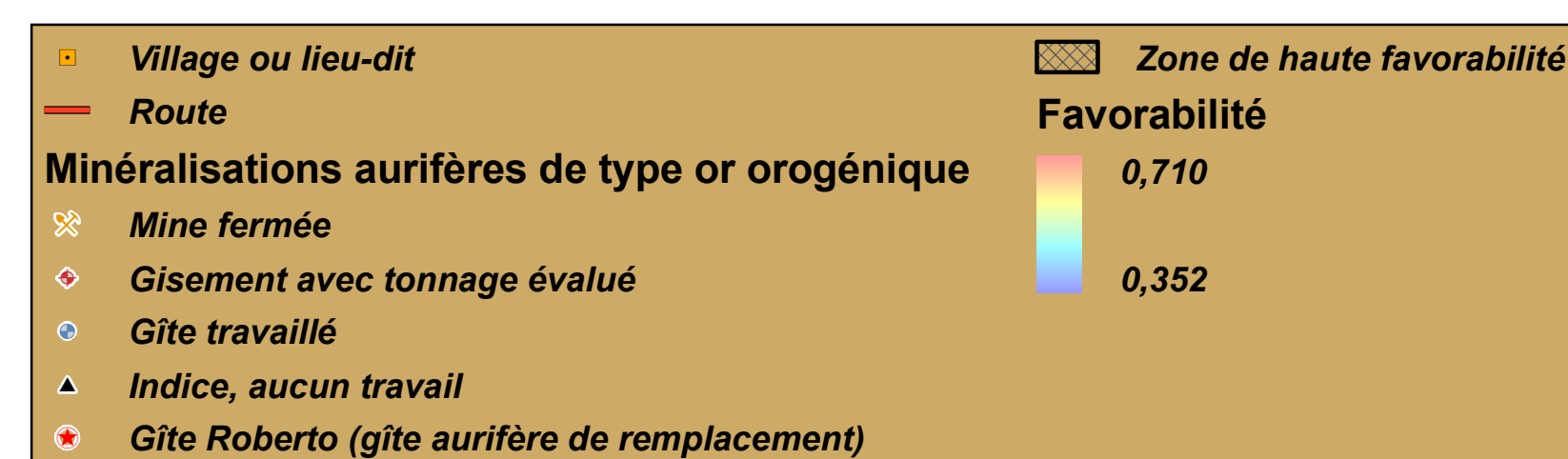
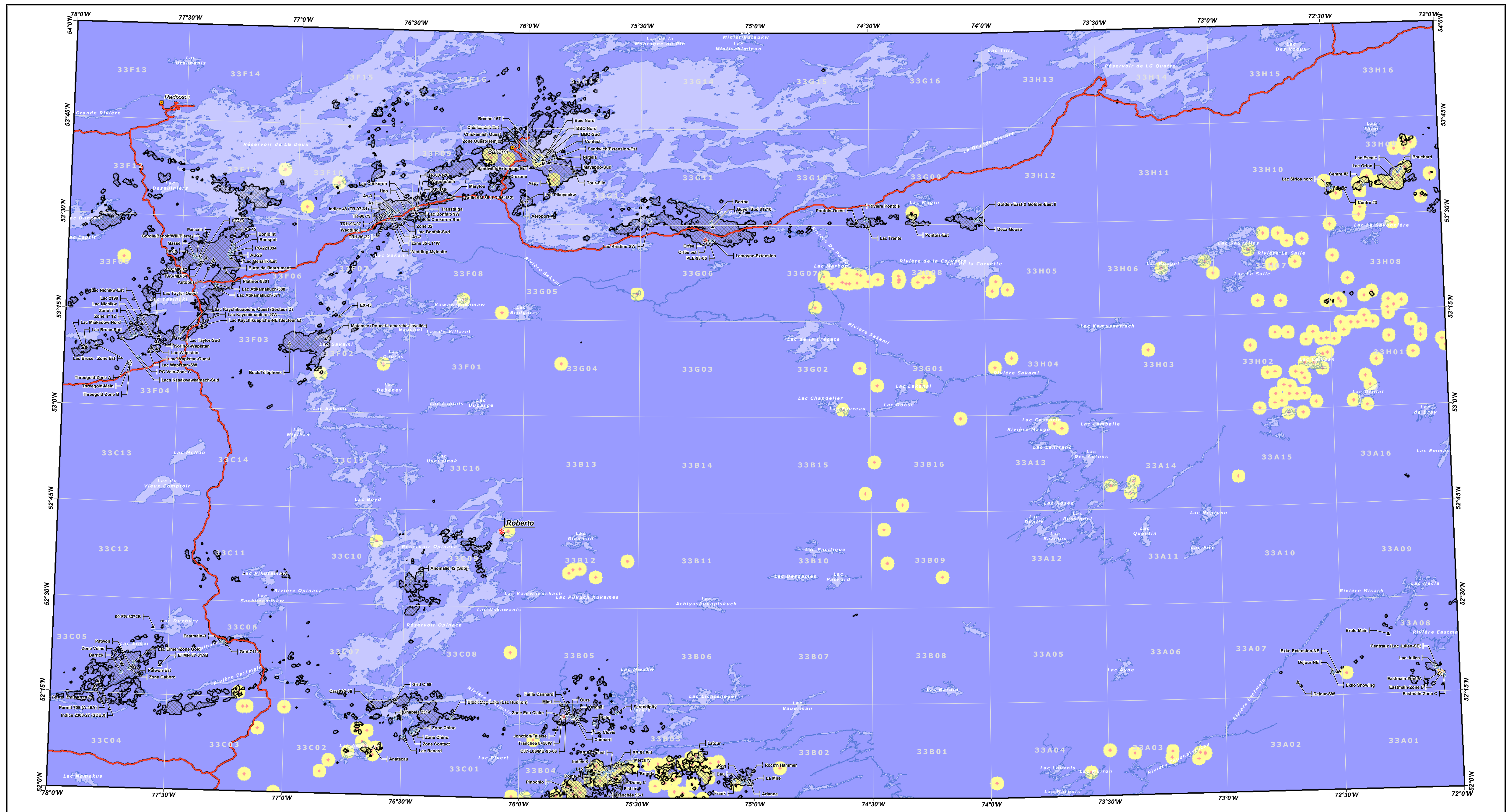
Carte A5.22
Proximité de valeurs favorables du
gradient magnétique vertical



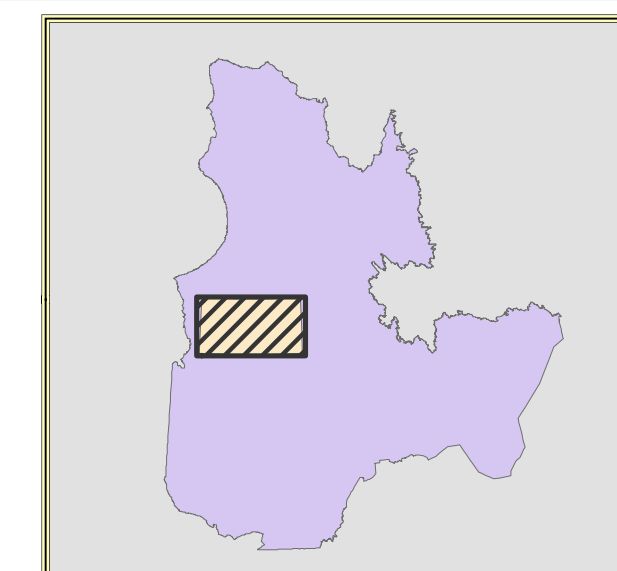
Projection : UTM NAD83, zone 18N
Source : EP 2008-01, MRNFQ

Ressources naturelles
et Faune
Québec

Potentiel en minéralisations de type or orogénique de la Baie-James

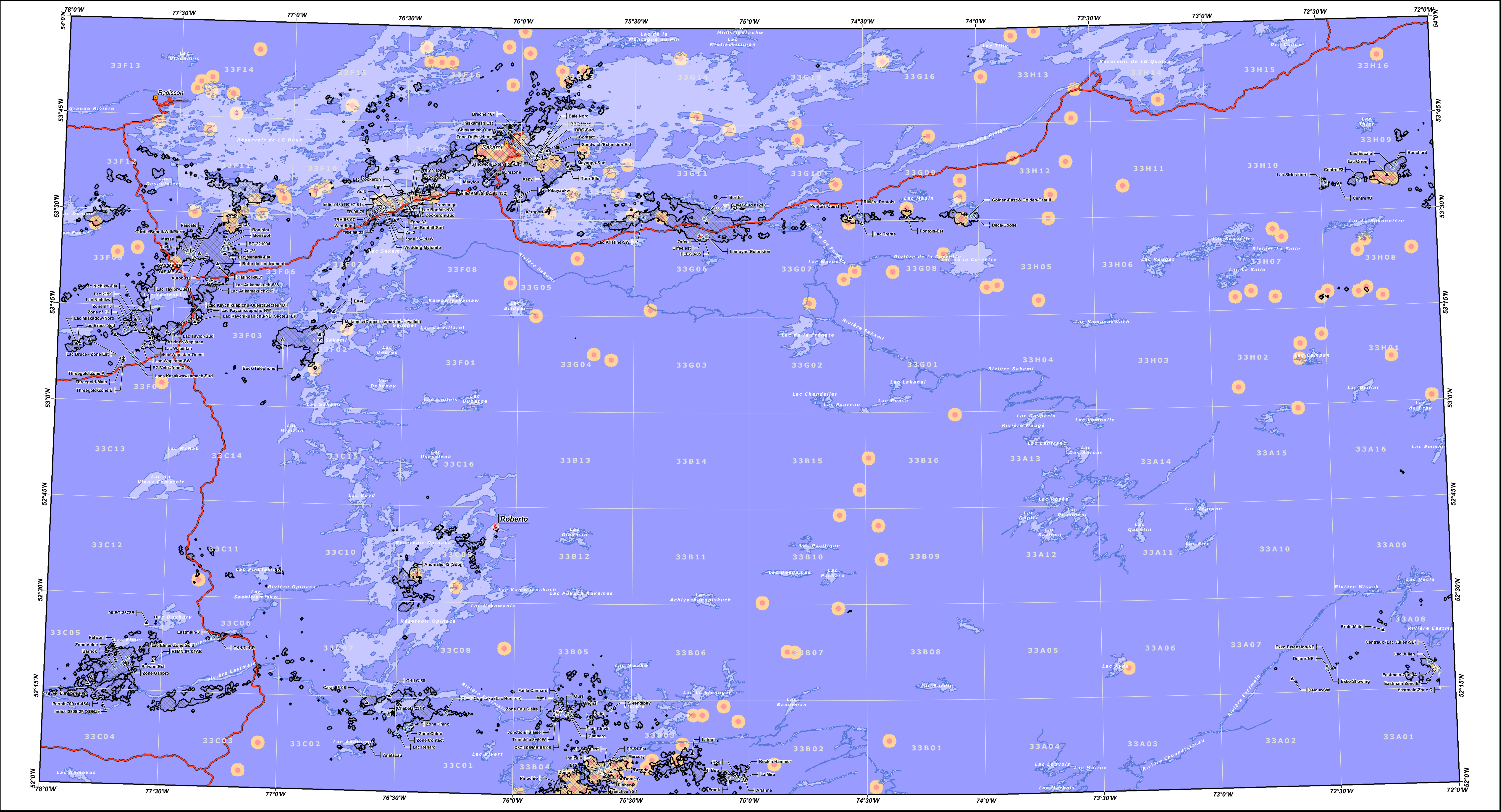


Carte A5.23
Proximité d'une anomalie en arsenic
dans l'environnement secondaire



Projection : UTM NAD83, zone 18N
Source : EP 2008-01, MRNFQ

Potentiel en minéralisations de type or orogénique de la Baie-James

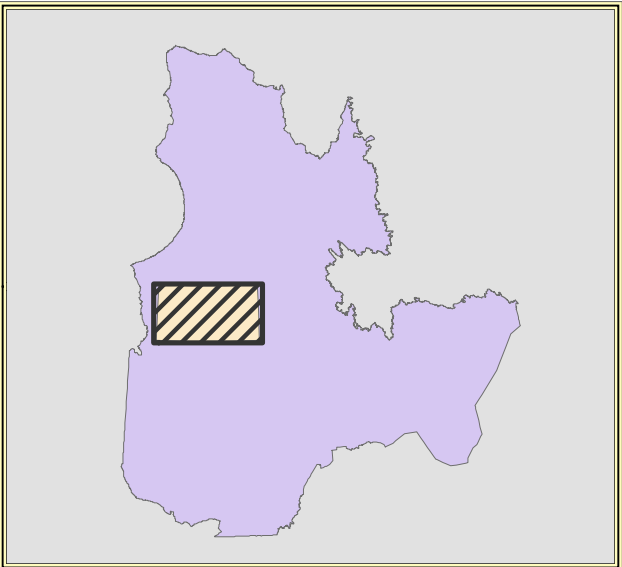


- Village ou lieu-dit
- Route
- Minéralisations aurifères de type or orogénique
- Mine fermée
- Gisement avec tonnage évalué
- Gîte travaillé
- Indice, aucun travail
- Gîte Roberto (gîte aurifère de remplacement)
- Zone de haute favorabilité
- Favorabilité
- 0,700
- 0,306

0 10 20 30 40 50
1:500 000 km

Carte A5.24

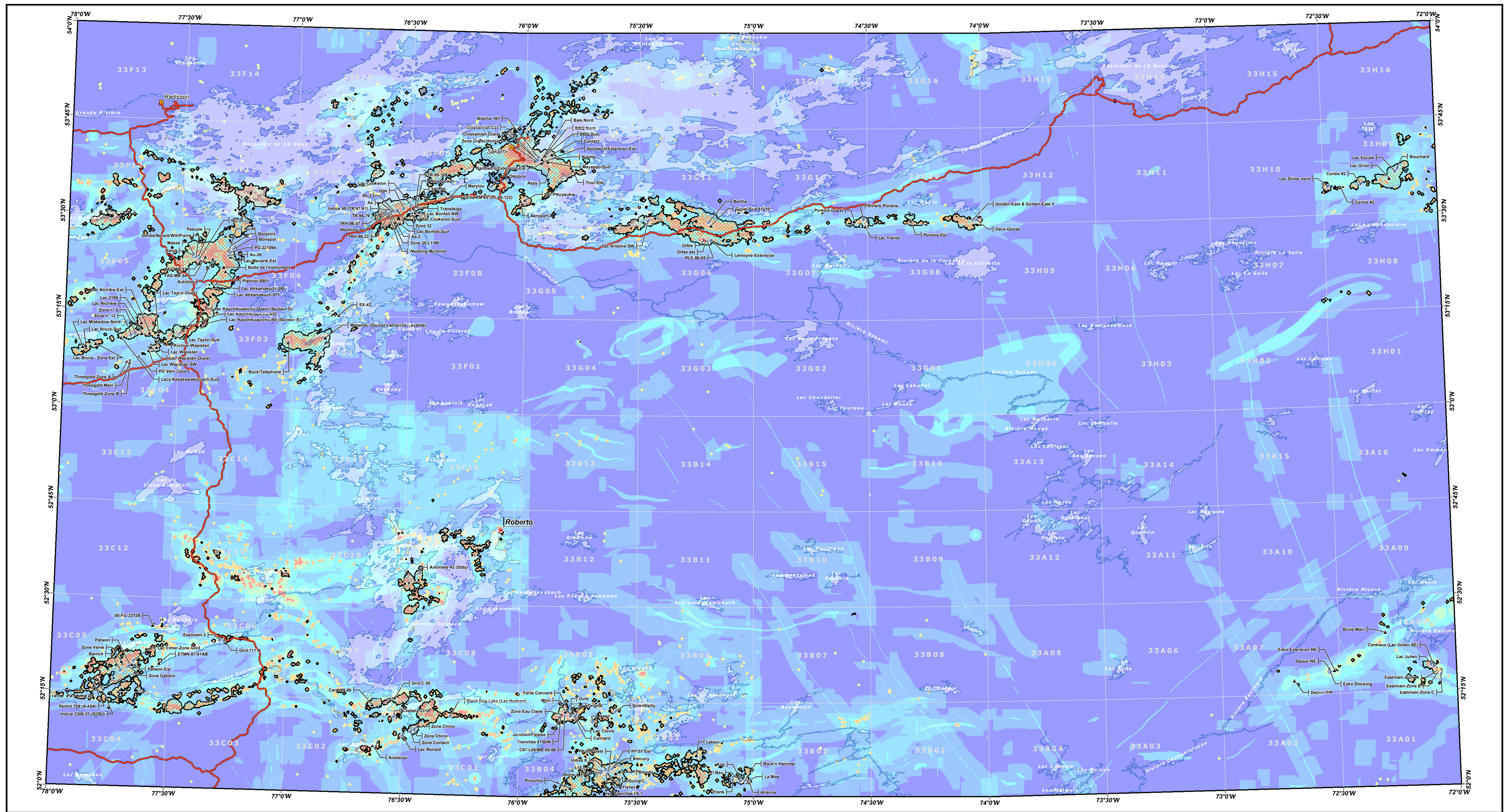
Proximité d'une anomalie en antimoine dans l'environnement secondaire



Projection : UTM NAD83, zone 18N
Source : EP 2008-01, MRNFQ

Ressources naturelles
et Faune
Québec

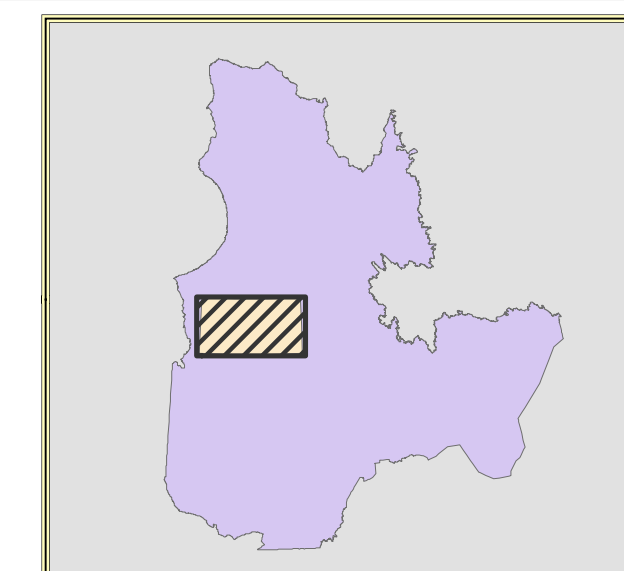
Potentiel en minéralisations de type or orogénique de la Baie-James



- Village ou lieu-dit
- Route
- Minéralisations aurifères de type or orogénique
- Mine fermée
- Gisement avec tonnage évalué
- Gîte travaillé
- Indice, aucun travail
- Gîte Roberto (gîte aurifère de remplacement)
- Zone de haute favorabilité
- Favorabilité
- 0,953
- 0,314

0 10 20 30 40 50
1:500 000 km

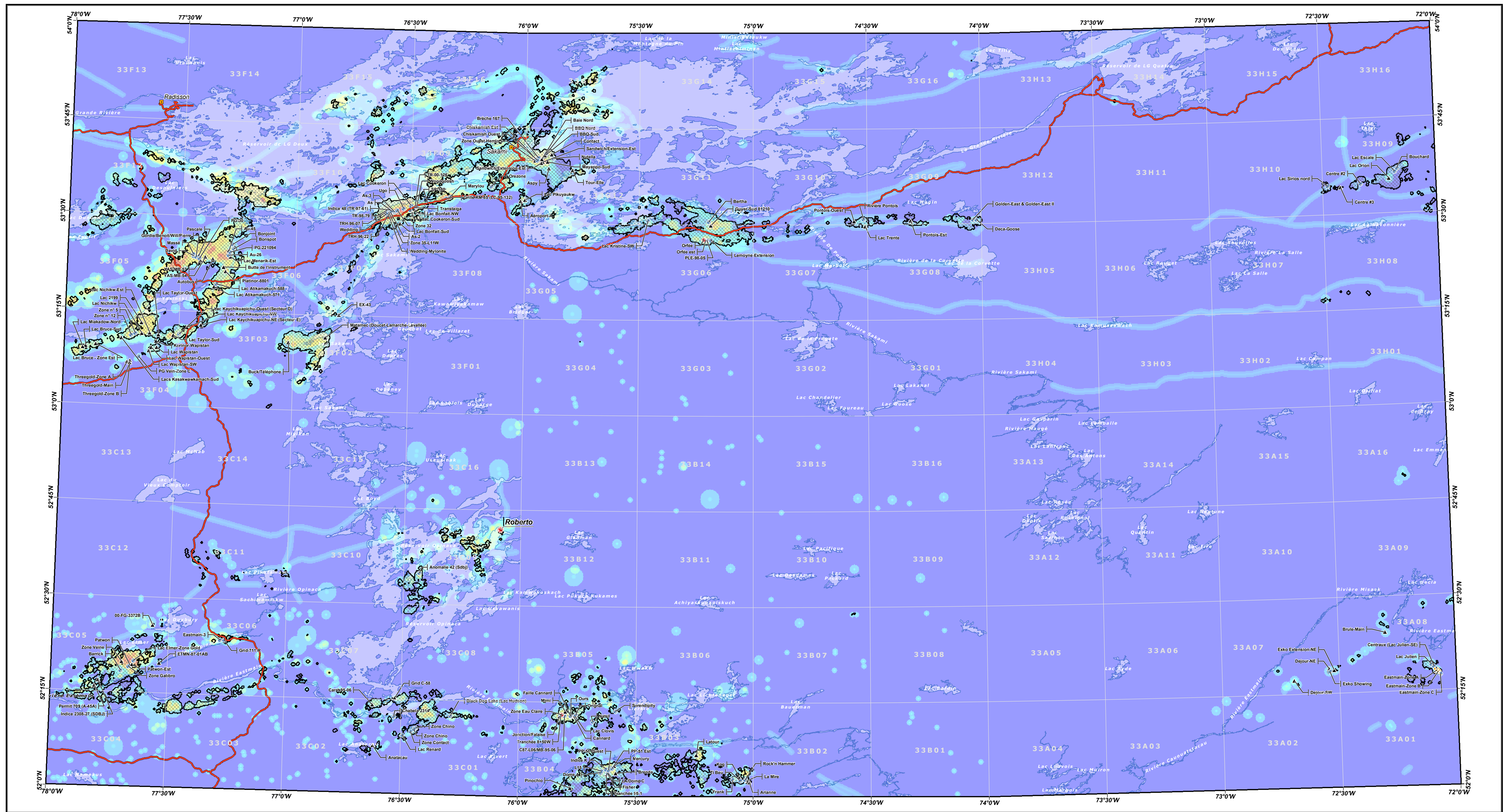
Carte A5.25
Favorabilité du contrôle lithologique



Projection : UTM NAD83, zone 18N
Source : EP 2008-01, MRNFQ

Ressources naturelles
et Faune
Québec

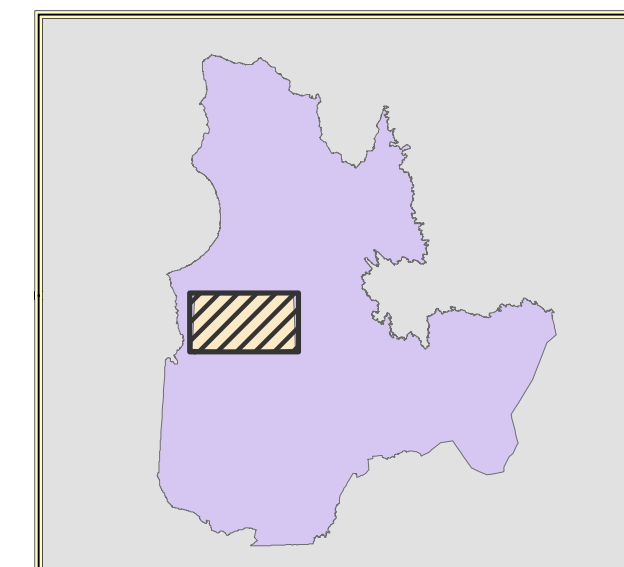
Potentiel en minéralisations de type or orogénique de la Baie-James



- Village ou lieu-dit
- Route
- Minéralisations aurifères de type or orogénique
- Mine fermée
- Gisement avec tonnage évalué
- Gîte travaillé
- Indice, aucun travail
- Gîte Roberto (gîte aurifère de remplacement)
- Zone de haute favorabilité
- Favorabilité
- 0,876
- 0,382

0 10 20 30 40 50
1:500 000 km

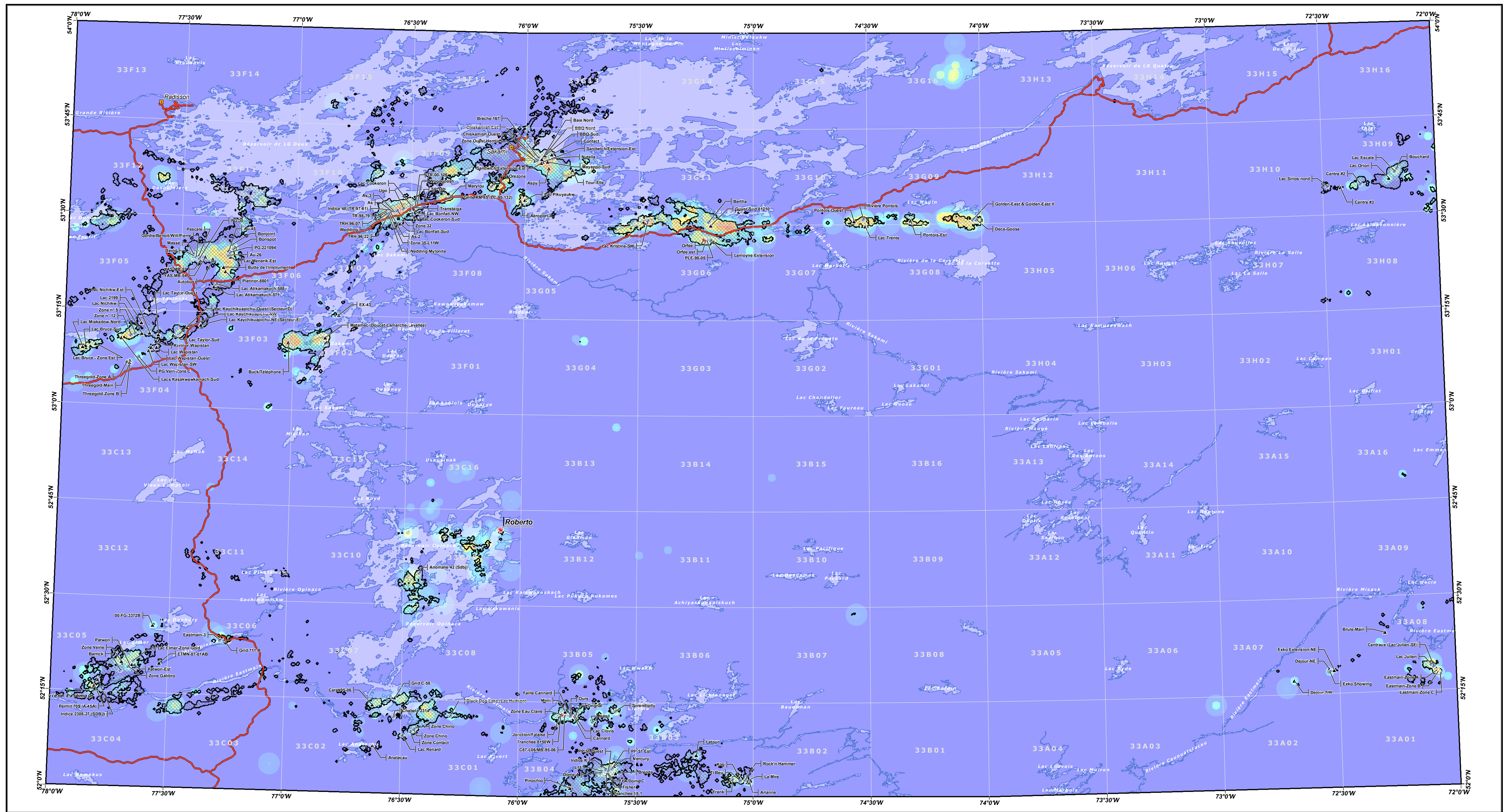
Carte A5.26
Favorabilité du contrôle structural



Projection : UTM NAD83, zone 18N
Source : EP 2008-01, MRN/Q

Ressources naturelles
et Faune
Québec

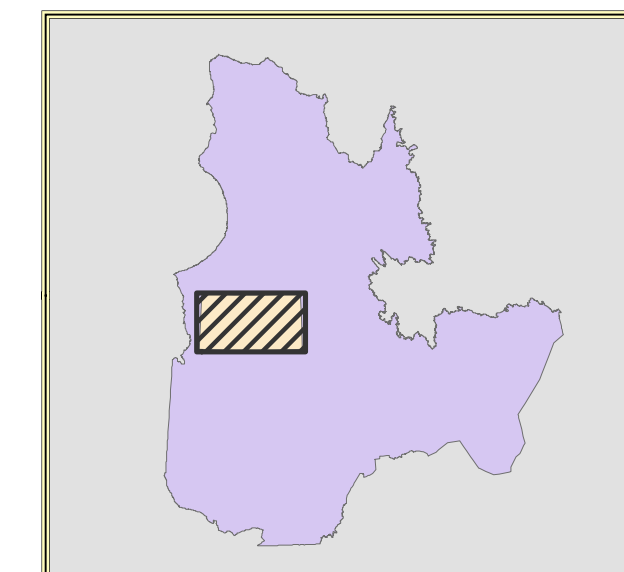
Potentiel en minéralisations de type or orogénique de la Baie-James



- Village ou lieu-dit
- Route
- Minéralisations aurifères de type or orogénique
- Mine fermée
- Gisement avec tonnage évalué
- Gîte travaillé
- Indice, aucun travail
- Gîte Roberto (gîte aurifère de remplacement)
- Zone de haute favorabilité
- Favorabilité
- 0,942
- 0,193

0 10 20 30 40 50
1:500 000 km

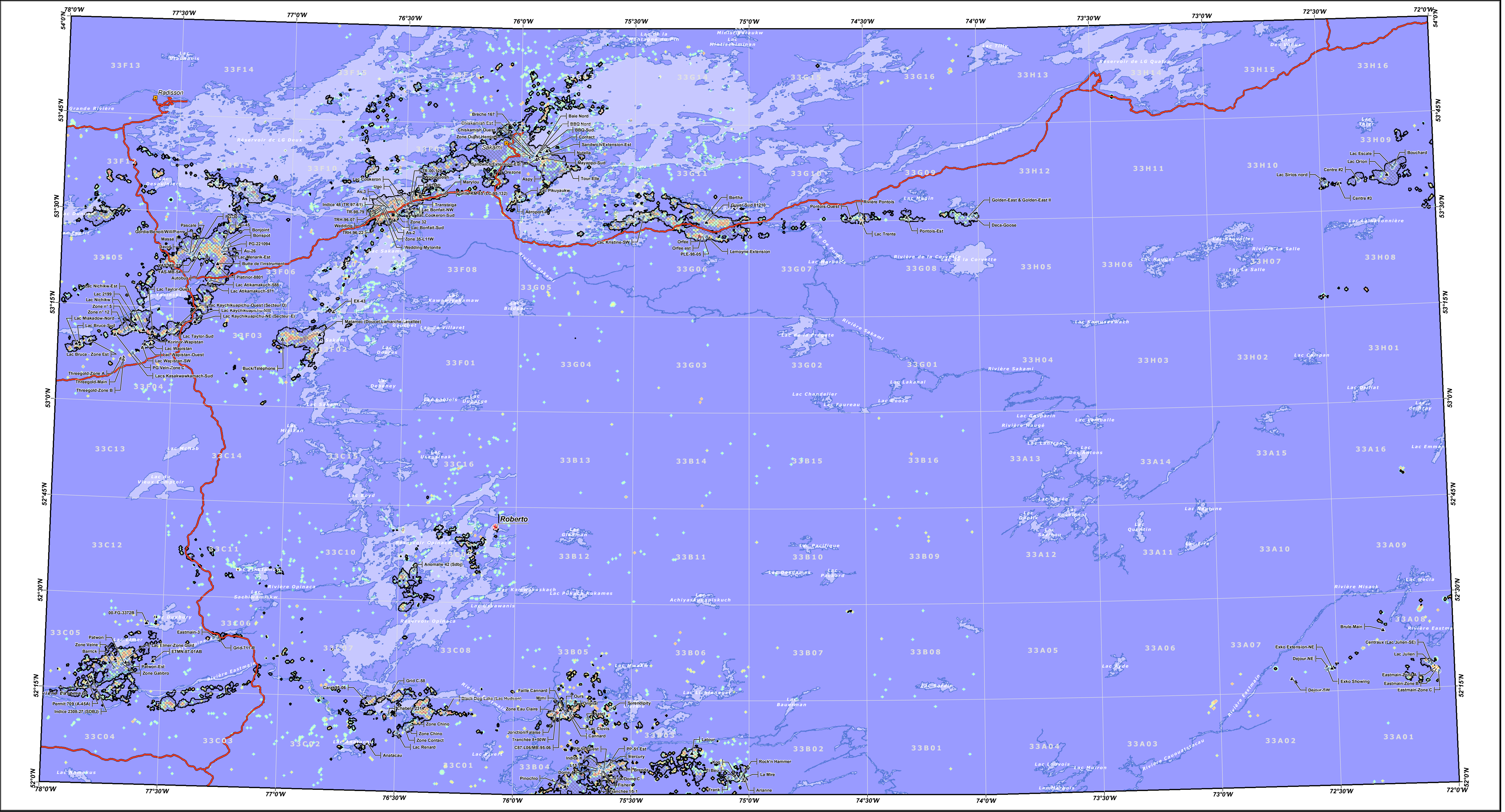
Carte A5.27 Favorabilité des indicateurs métalliques dans le substrat rocheux



Projection : UTM NAD83, zone 18N
Source : EP 2008-01, MRNFQ

Ressources naturelles
et Faune
Québec

Potentiel en minéralisations de type or orogénique de la Baie-James

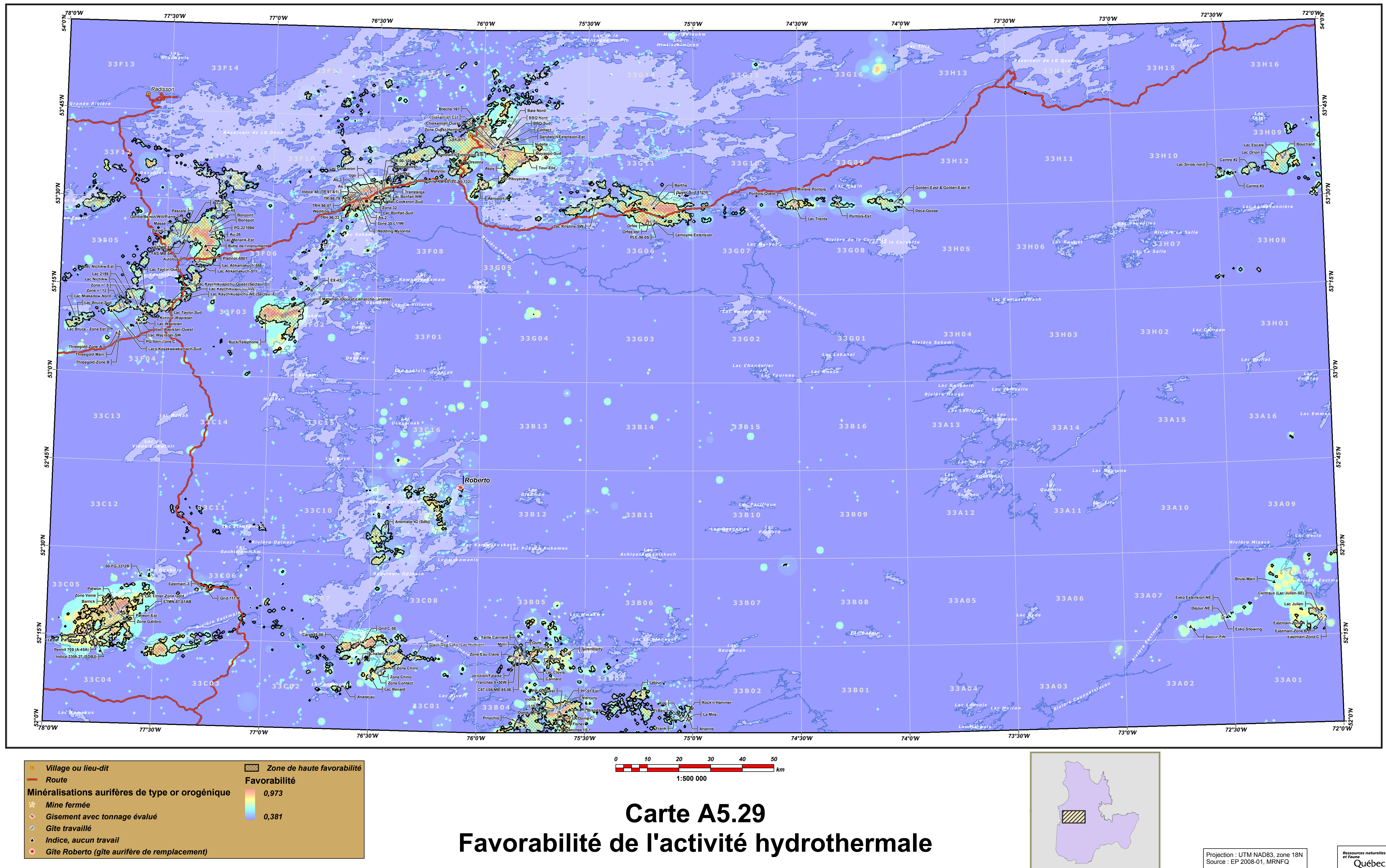


Carte A5.28
Proximité d'un minéral indicateur d'altération
ou de minéralisation

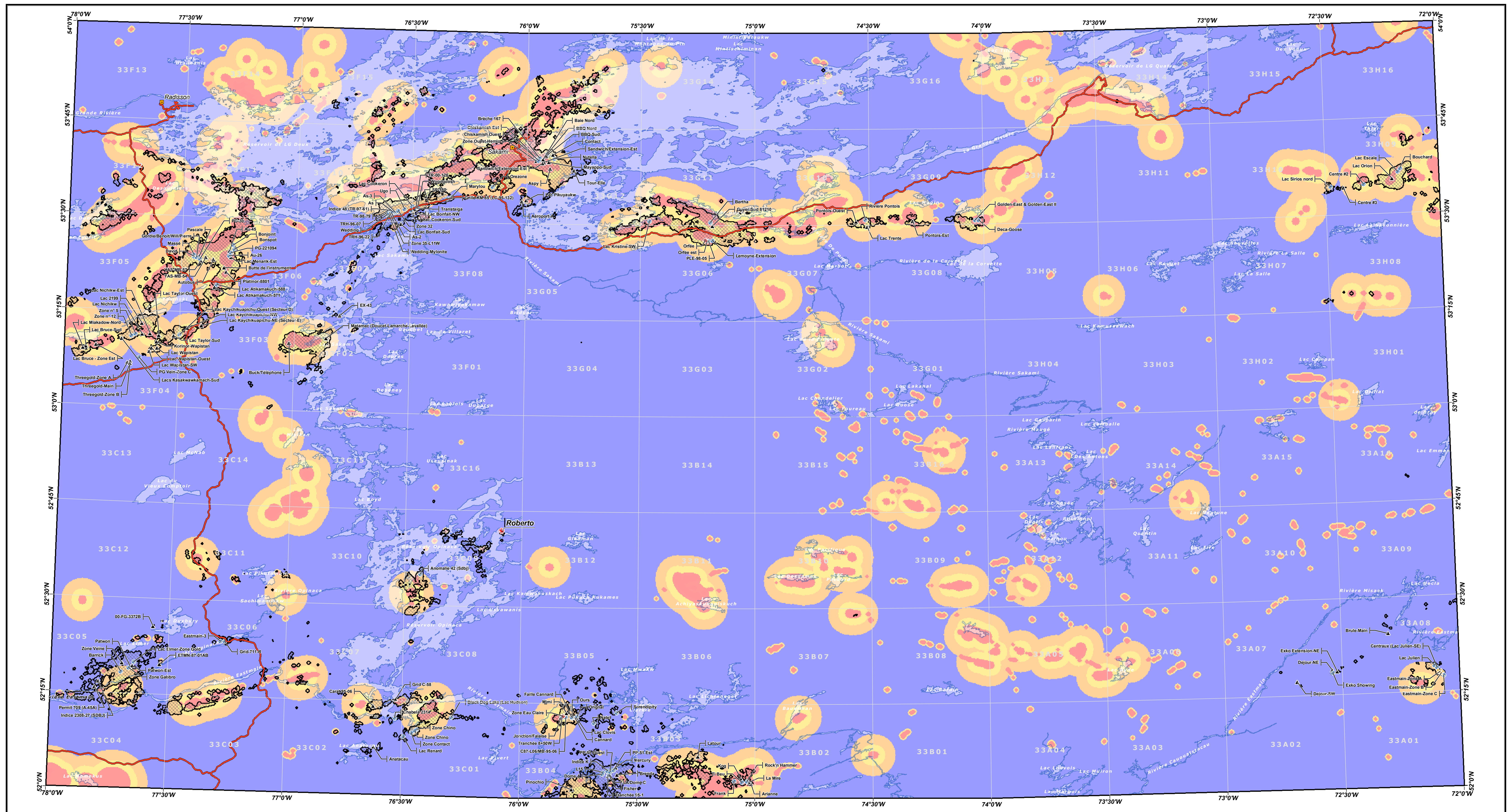
Projection : UTM NAD83, zone 18N
Source : EP 2008-01, MRNFQ

Ressources naturelles
et Faune
Québec

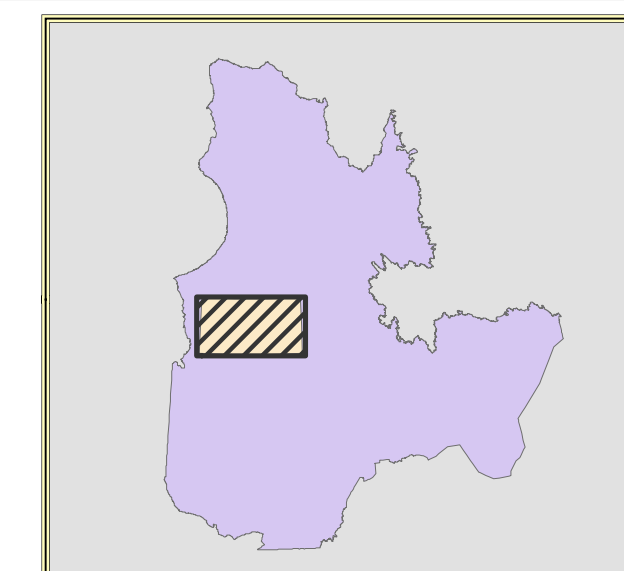
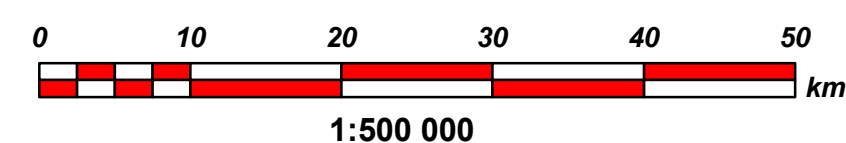
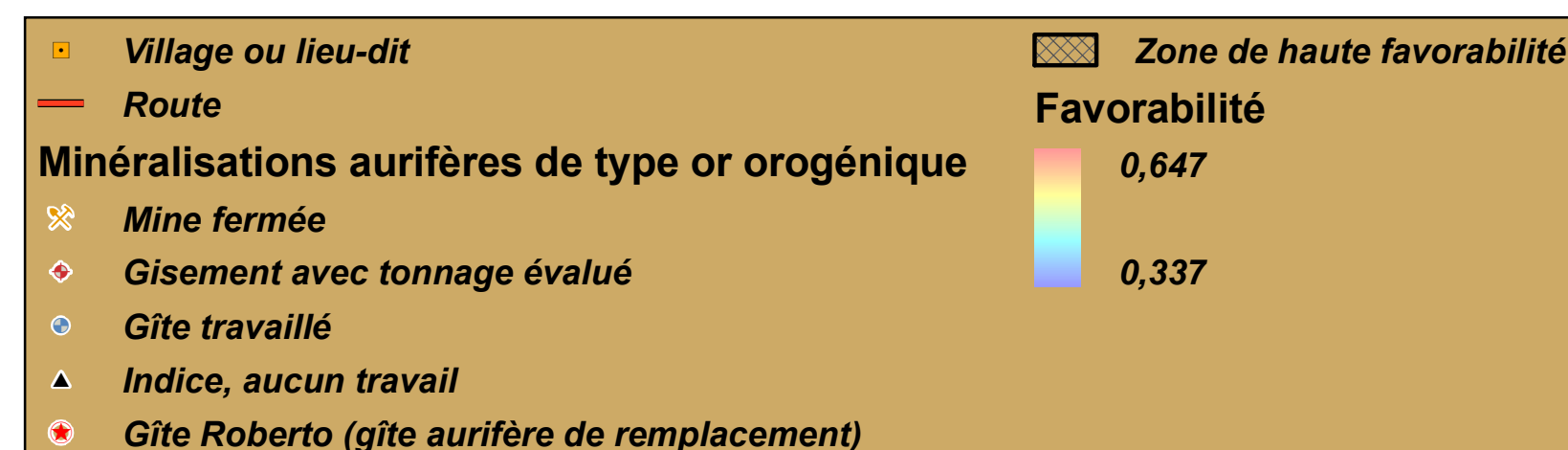
Potentiel en minéralisations de type or orogénique de la Baie-James



Potentiel en minéralisations de type or orogénique de la Baie-James



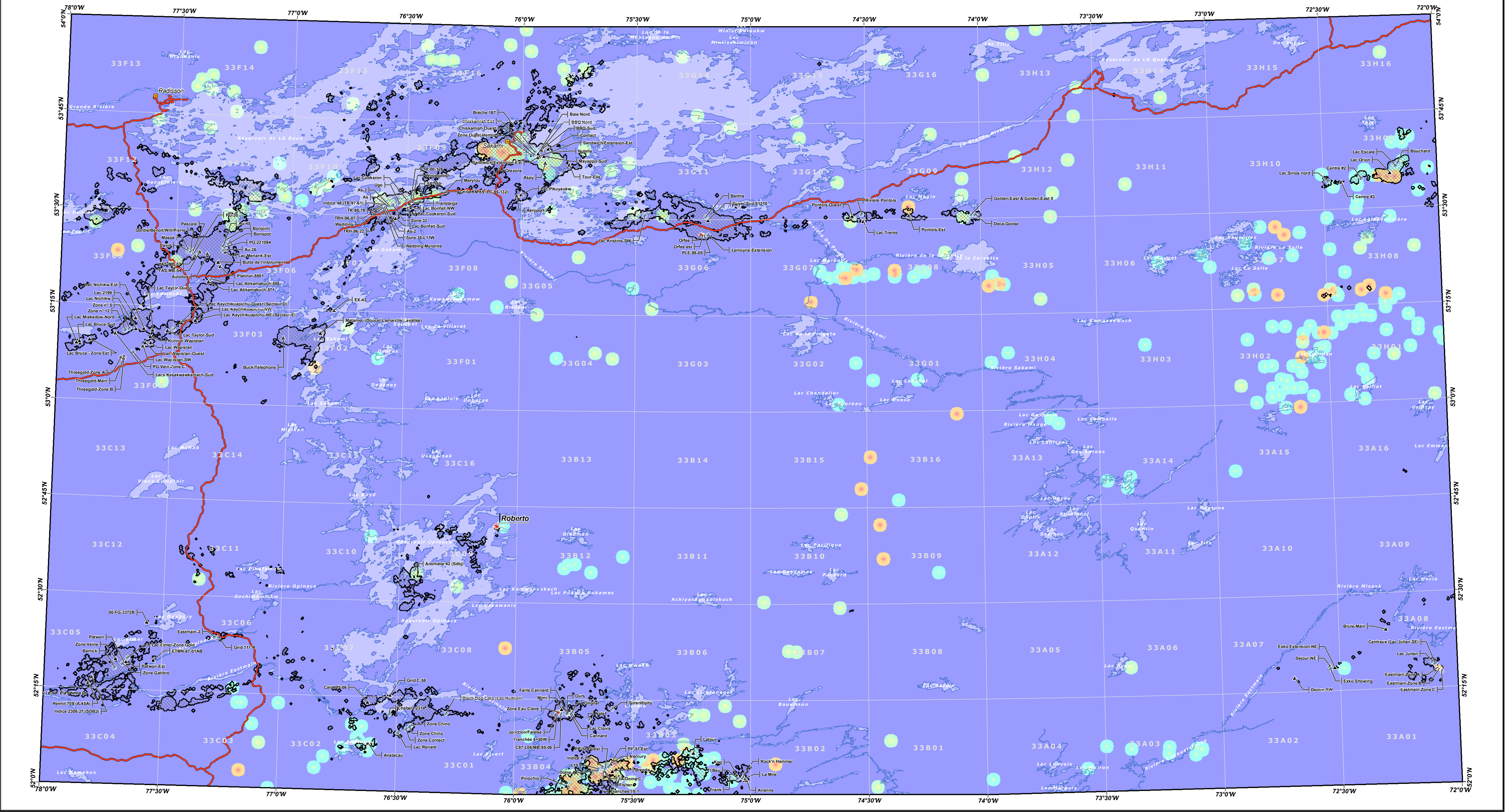
Carte A5.30
Favorabilité des évidences géophysiques



Projection : UTM NAD83, zone 18N
Source : EP 2008-01, MRNFQ

Ressources naturelles
et Faune
Québec

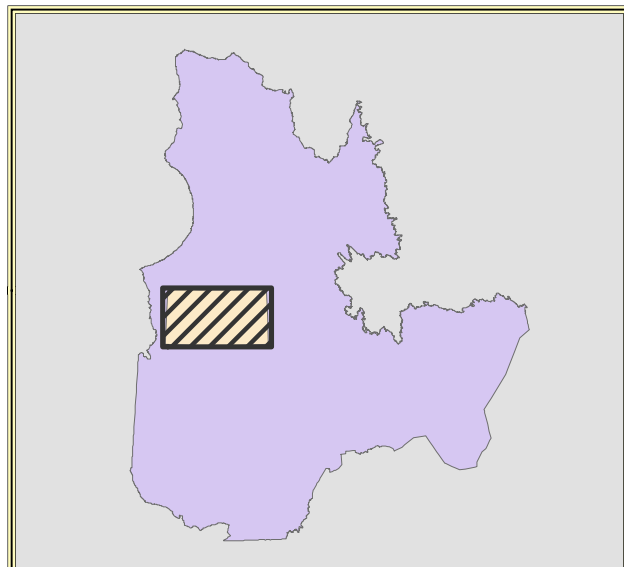
Potentiel en minéralisations de type or orogénique de la Baie-James



Carte A5.31
Favorabilité des évidences de
l'environnement secondaire

- Village ou lieu-dit
- Route
- Minéralisations aurifères de type or orogénique
- Mine fermée
- Gisement avec tonnage évalué
- Gîte travaillé
- Indice, aucun travail
- Gîte Roberto (gîte aurifère de remplacement)
- Zone de haute favorabilité
- Favorabilité
- 0,806
- 0,400

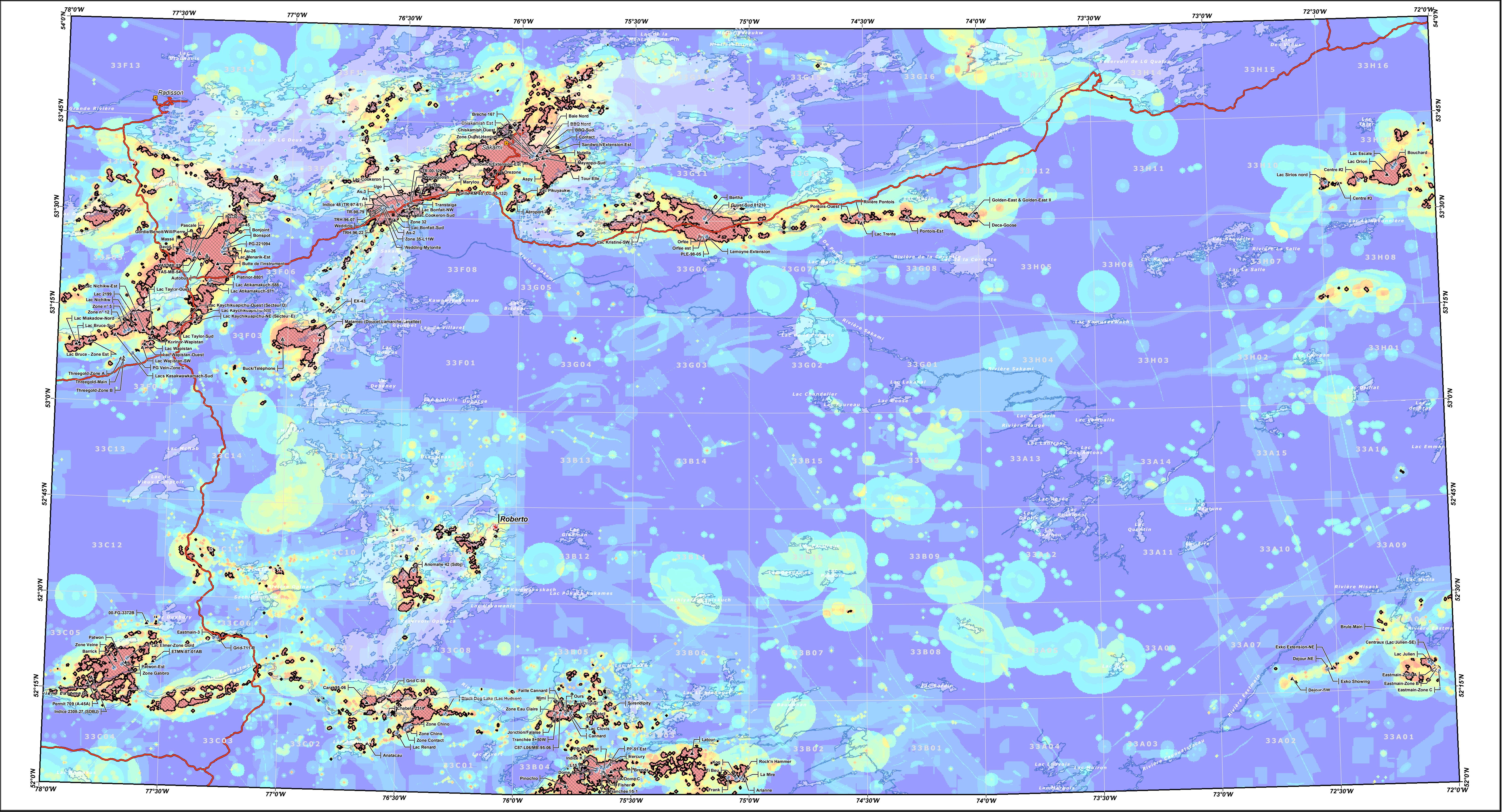
0 10 20 30 40 50
1:500 000 km



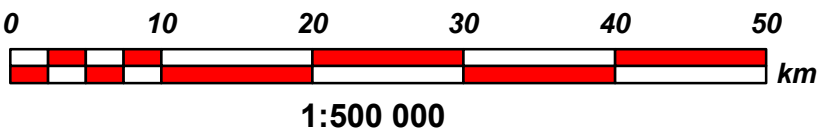
Projection : UTM NAD83, zone 18N
Source : EP 2008-01, MRNFQ

Ressources naturelles
et Faune
Québec

Potentiel en minéralisations de type or orogénique de la Baie-James

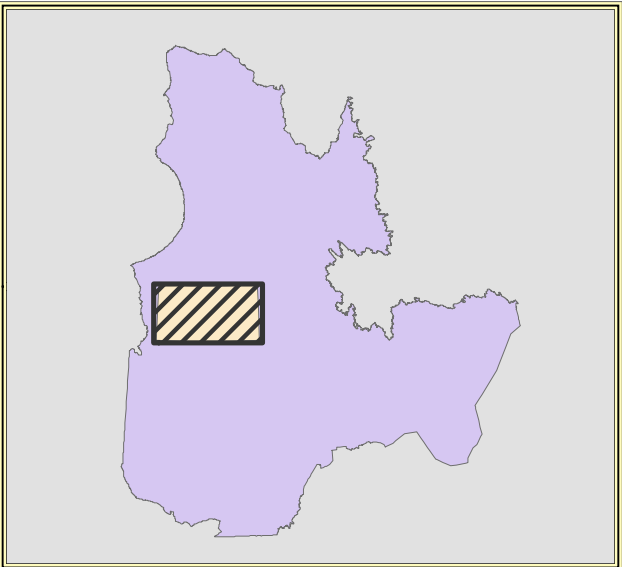


- Village ou lieu-dit
— Route
Minéralisations aurifères de type or orogénique
✱ Mine fermée
◇ Gisement avec tonnage évalué
● Gîte travaillé
▲ Indice, aucun travail
● Gîte Roberto (gîte aurifère de remplacement)
- Zone de haute favorabilité
Favorabilité
0,872
0,493



1:500 000

Carte A5.32
Favorabilité du potentiel en minéralisations
de type or orogénique



Projection : UTM NAD83, zone 18N
Source : EP 2008-01, MRNFQ

