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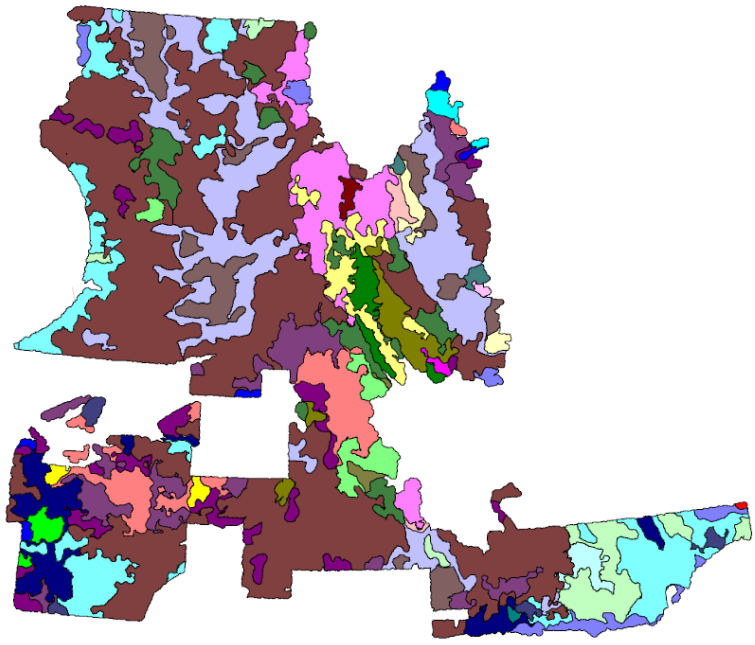
Consortium de recherche en exploration minérale

2004-09: Identification of geochemical domains

Regional lake sediment surveys are an essential mineral exploration tool in the little explored areas of northern Quebec. However, several problems arise when using them. First, analytical methods and the list of elements analyzed vary greatly from one survey to another, making the integration of data across the province difficult. Determining anomaly thresholds crucial for the delineation exploration targets is also difficult when working over large areas. Significant variations in the background levels of various elements limit the use of uniform anomaly thresholds for all of Quebec. The territory must therefore be divided into smaller areas with more uniform background levels and on small enough so that basic statistics can be carried out.



Geochemical domains plotted from data leveled bottom lake sediment of Ouebec and Labrador.

Gridded surveys for different elements across Quebec and Labrador show shifts in the values of different elements between surveys conducted at different times. These discrepancies are attributed to changes in analytical methods and in analytical laboratories. Levelling software was developed based on a known method to make corrections. Considering optimum coverage, the number of elements and the analytical quality, a set of 18 elements was selected for Québec and 12 for Quebec-Labrador combined.

Factorial multivariate analysis helped delineate geochemical domains. The observed geochemical variations are attributed to 1) lithological changes in the drainage basin of the various lakes, 2) different lake environments and 3) environmental effects of the drainage basin itself. Several factors may be correlated with major known geological assemblages and with dominant lithologies. The relationships between the values of factors and of variables related to the lake environment (lake depth, % organic matter, sediment color) indicate a clear correlation with the secondary environment. These correlations are as visible from a statistical point of view as from a cartographic point of view. Some elements are correlated almost exclusively with the clastic fraction (e.g. Mg, K, Ti), while others have strong affinities with the organic matter (e.g. Ca). As a result, the relative abundance of different fractions, thus the sediment type, closely controls the concentrations of various elements based on their geochemical affinity. These variations must be considered in determining the geochemical threshold anomalies for mineral exploration.

The delineation of geochemical domains was made based on the principal factors in the multivariate analysis. Domains were delineated by superimposing large ensembles formed from the main individual factors. These domains are thus areas where changes in the geochemical background levels are less important, and for which a statistical base can be calculated in order to retrieve anomalies.

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Summary: Project 2004-9	
Objectives	• To provide an effective methodology for characterising geochemical domains using lake-bottom sediments. • To identify and characterise geochemical domains. • To characterise the various associations of elements in order to identify potential mineralisation systems. • To generate exploration targets (IOCG, Ni, VMS, Au).
Results	• Normalised data for 18 chemical elements incorporating every survey carried out in Quebec and Labrador. • Factorial multivariate analysis and interpretation of factors in their geological and environmental contexts. • Recognition of the importance of environmental conditions of lakes for the chemical composition of lake sediments (lake depth, organic activity, types of lake sediments ➔ sand vs clay, etc.). • Defining major geochemical domains that can be used to adjust the threshold of geochemical anomalies using the regional background noise specific to each area.
Tools and Innovations	• Development of a new and very efficient method of normalisation. • Improved analytical and targeting tools based on geochemical domains.
Note	• Followed up in project 2005-3.
Special Collaboration	• Marc Beaumier, MRNFQ