2014-07:

PROJECT FOR THE INTEGRATION OF NI-CU-PGE MAGMATIC MINERALIZATION

Over the 15 years of the CONSOREM (since the year 2000), several projects have worked on similar thematic areas; this is particularly the case for the Ni-Cu-PGE (platinum group elements) magmatic systems in Quebec. Over this period, six projects have addressed this theme. However, although the subjects are related, each project is unique and original due to its approach (geochemical, structural, or geophysical) and achievements (such as geochemical tools to aid exploration and targeting for Ni-Cu and/or PGE). All these projects have helped to develop magmatic Ni-Cu-PGE exploration in Quebec.

With the marked amount of geoscience information, concepts, and models produced by these projects, a review is worthwhile to highlight some of these exploration methods using new data. For this application, two projects with different approaches were retained: one allows the discrimination of a signature for magma fertile for PGE mineralization through use of a profile of elemental ratios in a geochemical tool (tool RA-PGE - Project 2003-09); the other establishes a predictive mapping of ultramafic rocks in coupling radiometry data (vertical gradient) and Ni in lake sediments (Project 2007-02B).

The RA-PGE geochemical tool is applied to the lithogeochemical database of SIGÉOM 2014. The interest is to assess the potential of the samples spatially isolated from known Ni-Cu-PGE indices. After the treatment, 13 samples distributed within the Cape Smith Belt (James Bay), in the Belleterre Belt, and in the Gaspé show a real potential for metals and deserve to be studied further.

The methods of coupling the vertical gradient radiometry and Ni in lake sediments were applied to the James Bay region to target of ultramafic rocks enriched in Ni. The approach is based on several concepts: (1) ultramafic rocks (i.e., the least differentiated) preferentially concentrate Ni, as Ni is present in olivine whereas the fractional crystallization decreases the concentration of Ni in residual magma; (2) ultramafic rocks are poor in the radiogenic elements of K, Th, and U and, as such, will reflect radiometric troughs; and (3), ultramafic rocks are rich in magnetite and/or pyrrhotite and will therefore register high values along the vertical gradient. The 2007-02B project was undertaken on a sector of the Grenville Province. For the integration project, it was applied to the James Bay region (**Figure 1**). This choice was made due to recent geoscience information with numerous lake sediment samples of the sector being re-analyzed by ICP-MS (between 2010 and 2012) coupled with magnetic radiometric surveys (2009 to 2011) that cover this same sector. The Quaternary context is different James Bay and Grenville Province study areas. As such, changes were made to the targeting method. In the James Bay region, there is a thick and continuous coverage of Quaternary till as well as the presence of numerous lakes, making the radiometry obsolete despite a filtering of environmental parameters, and influencing values recovered from the lake sediments. An enhancement of the lake sediment anomalies through spatial regression cancelled out secondary environment artifacts, and to obtain non-biased values for the Ni residuals. Filtering was also necessary for the vertical gradient; values >14 nT/m are markers of iron formations. As well, for the targeting of ultramafic rocks in the James Bay area, only the high values of the filtered vertical gradient and Ni residuals in the lake sediments were effective. This combination of the vertical gradient and Ni residuals led to the identification of 15 km^2 of high priority targets, 9.9 km^2 of medium priority targets, and 25 km^2 of

lower priority targets (Figure 2). These targets are usually of small dimensions similar to sills or channelled coulees, which could be similar to the Raglan-type depositional model.

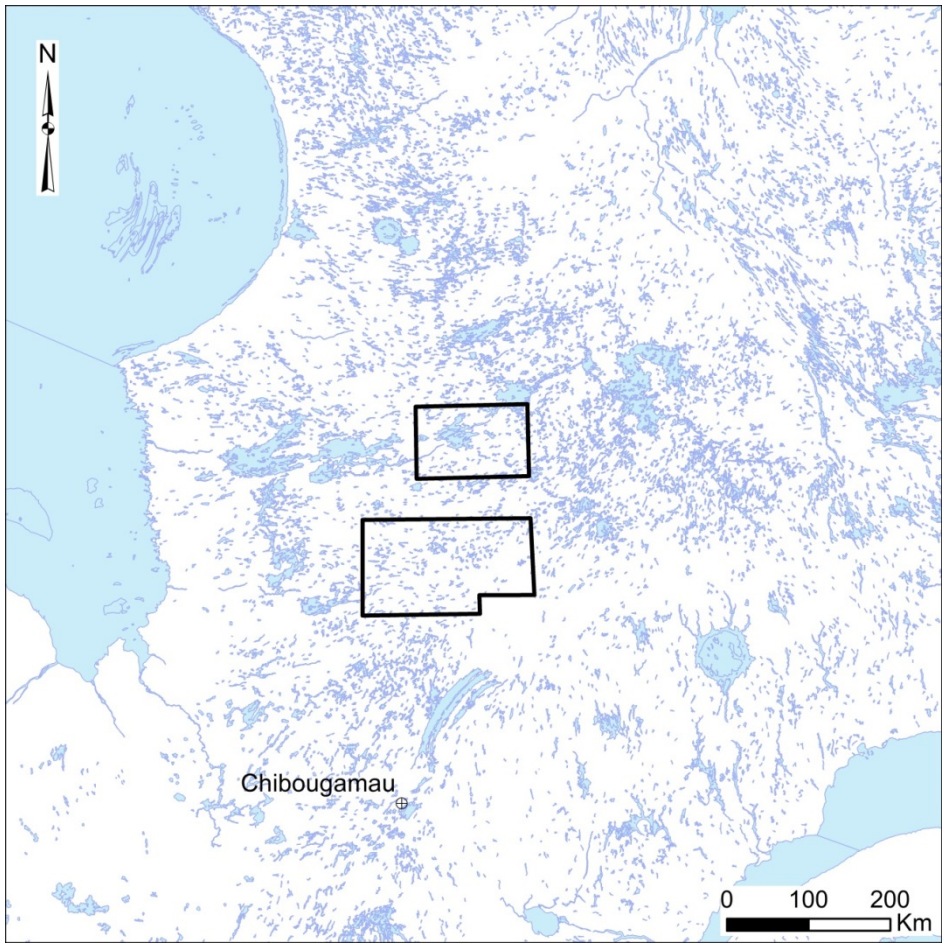

Figure 1. Location of the study areas (black polygons) for the targeting of ultramafic rocks.

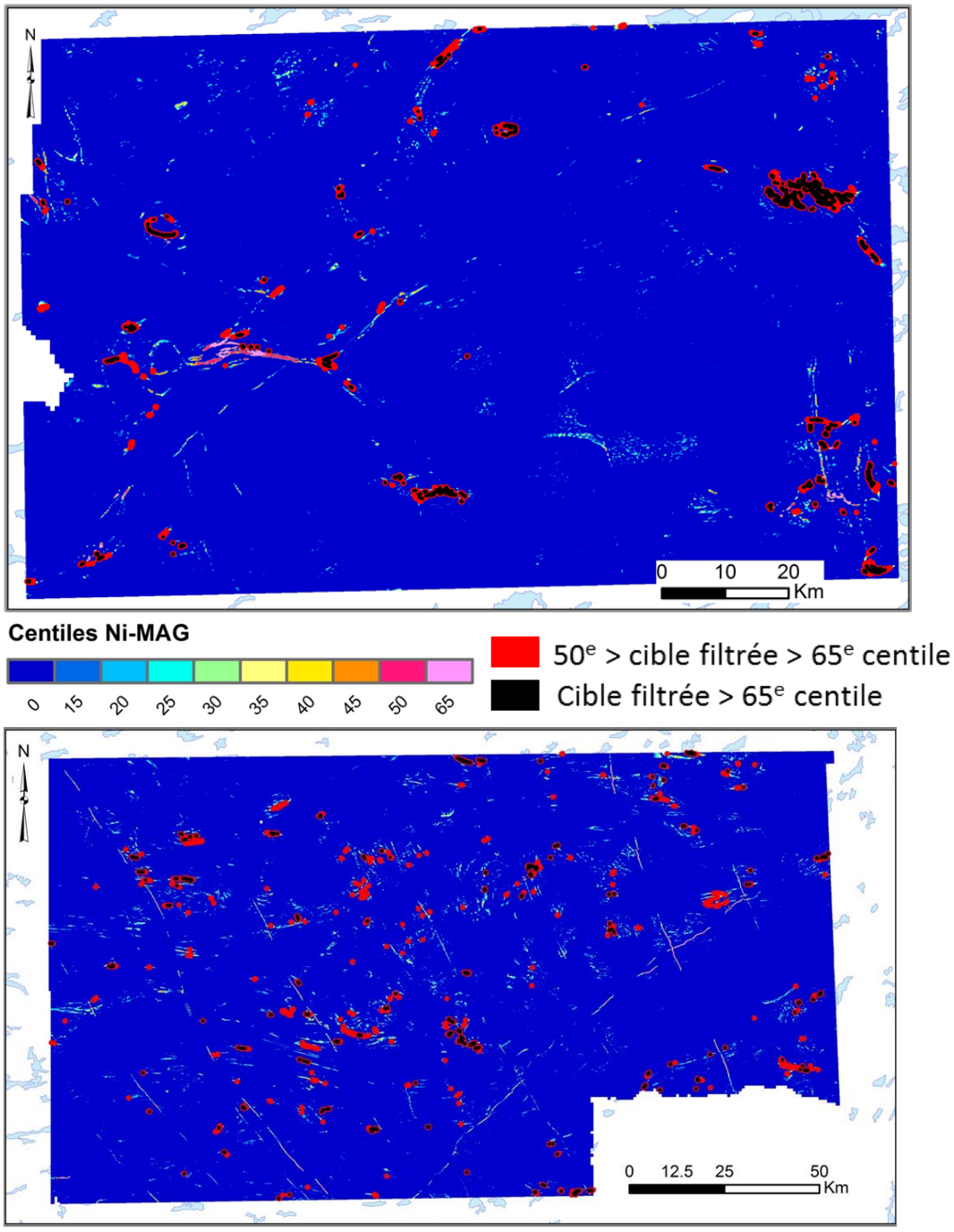

Figure 2. Targeting of ultramafic rocks in the James Bay area, with targets from the 50th percentile (red). The bottom map represents a combination of the filtered vertical gradient and the Ni residuals.

Project 2014-07 : Summary sheet	
Objectives	➢ Prepare a review and synthesis of CONSOREM projects dealing with magmatic Ni-Cu-PGE. ➢ Highlight some concepts and methods. - Application of the ***RA-PGE*** tool in Quebec and the targeting of ultramafic rocks in the James Bay region.
Results and innovations	➢ Six CONSOREM projects were reviewed. The projects varied in their geochemical, structural, and/or geophysical approach. Three projects led to the development of geochemical tools to help the exploration of Ni-Cu or PGE; three projects established maps of metal potential for Ni-Cu-PGE in the Grenville Province. ➢ Application of the RA-PGE in Quebec: Identification of thirteen sites, spatially isolated relative to the known Ni-Cu-PGE indices. The sites have a significant potential for containing PGE mineralizations within the Cape Smith Belt (James Bay), in the Belleterre Belt, and in the Gaspé. ➢ Predictive mapping for ultramafic rocks in the James Bay area by combining the high values of the filtered vertical gradient with the high values for Ni residuals in lake sediments. Targeting of 50.2 km^2 of favourable areas (at three levels of priority). ➢ Updated method of targeting for ultramafic rocks of the James Bay sector without influence from the secondary environment.