

2014-04:

REGIONAL EXPLORATION GUIDES FOR Cu, Au, Mo (Pb, Zn) PORPHYRIES AND SKARNS IN THE GASPÉ REGION

The potential for major porphyritic deposits in the Gaspé region has been known for several decades following the discovery of world class deposits in Murdochville. This discovery motivated several decades of exploration, albeit relatively in vain...This project's mandate was to therefore reassess this potential, revisit the existing data and exploration concepts, and to develop new approaches for a regional exploration of these deposits.

Intrusions documented in the Gaspé region are essentially Devonian in age, syn- to late-Acadian orogeny, manifested by a NW–SE transpression (re)activating the large systems of deep WSW–ENE to ESE–WNW rupture. These intrusions form smaller plutons that occasionally pierce through the Siluro-Devonian sedimentary cover of the Gaspé and are found in a greater concentration in the central-northern portion of the peninsula where they form the "igneous triangle", a sector mainly composed of plutonic and volcanic rocks. Although still enigmatic and controversial, Acadian geodynamics is likely to be collisional-type, post-subduction with crustal thickening. In other words, this produces a context that is conducive to magmatic hydrothermal deposits being more likely gold than purely copper anomalies (magmas derived from the fusion of a lower crust are metasomatized beforehand by subduction). This interpretation is perfectly corroborated by the assemblage found at Gaspé Mines: Cu-Au-Mo. It, therefore, initially appears that favourable regions are concentrated along the few, yet well-known, large dextral Acadian faults as well as within the igneous triangle in the centre. Along the faults, more local controls are connected to tension relays or inflections of fault line, such as the spectacular relay system of the Gaspé Mines, conducive to the formation of vertical drains driving magmatic ascension (pulsed possibly by the periodic slip of the fault).

Furthermore, a significant portion of New Brunswick (NB) is covered by an outcropping, essentially Devonian, of a plutonic belt comprised of a very well-documented, hydrothermal magmatic metallogenic belt. It is proposed that this "Acadian Arc" extends to the NE, under the centre of the Gaspé, where it forms significant plutonic masses that are buried under the sediments of Gaspé. It outcrops locally to produce the igneous triangle and to produce the dykes and observed plutons situated along the faults. The arguments are essentially based on the synchrony and the analogy of geochemical affinities with the Gaspé intrusions as well as the presence in the centre of the Gaspé Peninsula of a very marked, positive magnetic anomaly, of great wavelength, transverse to the structural grain and extent of the axis of the Acadian Arc in NB. Based on the continuity of this metallogenic belt, a new approach focuses on the magmatic metallogeny of Gaspé. Several very innovative exploration guides can be used, exported from the very well-documented magmatic metallogeny in NB:

1. In NB, there are two types of magmatic gold deposits: 1) the classic porphyritic-type, with the associated skarns (Nicholas-Denys, Connel Mountain, Déboullie deposits, etc.) and the "Reduced Intrusion-Related Gold Systems"-type (RIRGS: Clearance Stream, Poplar Mountain).

This latter type, which has never been explored in the Gaspé, presents characteristics very distinct from the first especially with the presence of the Au-Sb-As assemblage, a disposition within massive veins having limited alteration, distal vis-a-vis intrusional, and a reduced magma (via supracrustal contamination?) typically of the ilmenite +/- magnetite series. This matches with several Au-Sb-As mineralizations described in the Gaspé (i.e., Beaver deposit) but is not recognized as RIRGS, as the formal and rigorous description of this genetic model by the authors is relatively recent. Several mineralizations described as epithermal gold could prove as belonging to this category. A final type consists of the Sn greisen-type (Mount Pleasant), typically linked to the even more reduced and later (post-Acadian) magmas.

2. To investigate the existence of discriminating geochemical signatures that permit an assessment of the fertility of Gaspé intrusions for these different types of deposits, we analyzed the REE-HFSE spectra for intrusions associated with deposits and known indices, in NB and the Gaspé. The spectral signatures form three very homogeneous and very discriminating groups for the three types of magmatic deposits described above (porphyritic, RIRGS, and Sn greisens). These signatures were therefore searched for in the Gaspé Peninsula and several geochemical targets were identified for the porphyry and the RIRGS. In contrast, significantly no intrusion of gaspesian intrusion has an analogous signature to that of Sn greisens in NB, as the magmas are likely not reduced enough.

The application of geochemical proxies exported from NB to deposits in the Gaspé Peninsula shows significant differences between the intrusions of the igneous triangle (centre-north) and those observed along the Acadian strike-slip faults (Grand Pabos Fault): the intrusions in the igneous triangle are potential porphyritic deposits, while to the south, the Grand Pabos Fault and its surroundings contain both types of intrusions, notably dominated by RIRGS intrusions at its extreme eastern end. Moreover, at these latter locations, Au-As indices were reported around reduced intermediate intrusions ($\text{Fe}_2\text{O}_3/\text{FeO} < 0.4$). In addition, targets for geochemical intrusions having a high potential for porphyritic deposits were detected by their Sr/Y ratio (Rohrlack and Louck, 2005) and use of an empirical index developed during Project 2011-07.

At the same time, a regional compilation of several recent high-resolution magnetic surveys carried out by the Geological Survey of Canada has allowed for the systematic detection of plutons having potential porphyritic deposits. Analogous to the signatures of the plutons from the Sullipek, Gaspé Mines, and Mid-Patapedia deposits, the sought 'mag' signature is a positive anomaly of low wavelength, being punctual, irregular "potato-shaped", and spatially restricted (diameter approx. 1 km), cutting across the structural grain and contrasting sharply with the surrounding sediment. These signatures are enhanced very effectively via the horizontal derivative by increasing the colour chart toward very high values. Several targets were detected through this approach, taking care to avoid the anthropogenic anomalies (ex. factories) that give off very similar signatures.

Finally, the region is fully covered by surveys of the bottom sediments of streams, making up a database of more than 120 000 samples collected over several decades. This recent project benefits from a series of in-depth analyses performed during a previous project (2009-02):

sorting by protocol, analysis of background noise, standardization of surveys, enhancement of anomalies. This previous project had statistically developed several exploration indices for which their use had not been widely applied. Several anomalous watersheds were therefore identified by specific assemblages of anomalies that suggest the presence of porphyritic mineralization, skarns, or RIRGS.

Several innovative approaches have been described in this study. The overlap of anomalies from the secondary environment with geochemical targets and intrusions detected by high-resolution 'mag' surveys has led to several sectors being proposed as having a high potential metallogeny.

Project 2014-04: Summary sheet	
Objectives	<ul style="list-style-type: none"> ➤ Reassessment of the potential of the Gaspé Peninsula for porphyritic deposits. ➤ Proposal for new strategies of regional exploration. ➤ Determination and targeting of favourable sectors.
Results and innovations	<ul style="list-style-type: none"> ➤ Innovative approaches proposed, and targeting: <ol style="list-style-type: none"> 1. Geochemical targeting, fertility of the intrusions determined by: the Sr/Y ratio, the Faure criteria (Project 2011-07), the analogy of REE-HFSE spectra with the mineralized intrusions documented for the Appalachian Mountains (New Brunswick and Quebec). 2. Highlighted a potential for "Reduced Intrusion-Related Gold Systems" (RIRGS) → model of innovative exploration in the Gaspé. 3. Determination of the 'mag' signature of plutons being potential porphyritic deposits → geophysical targeting. 4. Regional integration: recognition of favourable/unfavourable regions in function of the context global geodynamics. 5. Original treatment of sediment surveys from streams: combinations of anomalous elements specific to skarns, porphyries, and RIRGS → targeting of the secondary environment.