Grenville Province

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Introduction

The Grenville Province extends for more than 2,000 km along the north shore of the St. Lawrence River and ranges from 300 to 600 km wide. It forms the southeastern part of the Canadian Shield, from Labrador (northeast) to the Great Lakes (southwest). The Grenville Province is divided into three major lithotectonic elements: the Parautochthonous Belt, the Allochthonous Monocyclic Belt, and the Allochthonous Polycyclic Belt (Rivers *et al*., 1989). Archean rocks of the Superior Province and Paleoproterozoic rocks of the Otish basin and New Québec Orogen are separated from the Parautochthonous Belt by the Grenville Front (Figure 1E-1), a major and complex structure oriented northeast-southwest. The Front is characterized by a northwest-verging thrust movement and by late strike-slip movements (Hocq, 1994).

The Allochthonous Monocyclic Belt comprises allochthonous terrains that underwent a single orogenic cycle. In the western part of the Grenville, the Allochthonous Monocyclic Belt is composed of the Morin and Mont-Laurier terranes, and in the eastern part, of the Wakeham terrane. These terranes consist mainly of supracrustal rocks intruded by mafic and ultramafic dykes and sills, anorthositic suites (Morin Complex), and granitoids.

In the immediate vicinity of Sept-Îles, Grenvillian rocks are intruded by the Eocambrian (565 Ma) Sept-Îles Layered Igneous Complex. Farther east, in the Baie des Moutons area, an Eocambrian syenite complex intrudes Grenvillian bedrock.

In the following two sections, the most significant exploration projects undertaken in the Grenville Province in 2004 will be described according to the type of ore deposit under investigation. The first section deals with the western part of the Grenville Province (which includes the Outaouais, Laurentides, Lanaudière, Mauricie, Portneuf, Québec, Charlevoix, and Saguenay – Lac-Saint-Jean regions), whereas the second focuses on the eastern Grenville (the entire Côte-Nord region).

Western Grenville Province

In 2004, **Géologie Québec** carried out a new geological survey at 1:50,000 scale in the western part of the Grenville Province, in the Lac Pine and Lac Adonis area (NTS sheets 31 O/02 and 31 O/06), northeast of Mont-Laurier (Nantel *et al.*, 2004). This mapping program was conducted within the scope of a mineral potential assessment of prospective areas for SEDEX-type copper and zinc deposits, industrial minerals, and dimension stone. **Géologie Québec** continued its geological, metamorphic, and metallogenic synthesis of the Grenville Front in the Chibougamau area, with a mapping survey along the Grenville Front in the Lac Lagacé (32 B/14) and Lac Mitshisso (32 H/13) areas (Cadéron *et al.*, 2004). This synthesis is performed in conjunction with a project to develop a 3D geological model along the Grenville Front, in partnership with the **Université du Québec en Abitibi-Témiscamingue** (URSTM), **Université du Québec à Montréal** and **Université Laval** (Rabeau *et al*., 2004). **Géologie Québec** also conducted an assessment of the sillimanite and muscovite potential in the Mont-Laurier area (Togola *et al*., 2004) and took part, along with the **Université Laval**, in a study of Ni-Cu-PGE showings in the Portneuf-Mauricie belt (Sappin *et al*., 2004).

MAGMATIC NI-CU (CO-PGE) DEPOSITS

The western Grenville Province contains a number of anorthositic massifs as well as several generations of mafic dykes, plutons and complexes, which offer an excellent potential for magmatic Ni-Cu (Co-PGE) deposits. The most prospective areas appear to be associated with major regional structures that serve as terrane boundaries and that transect or border anorthositic complexes. Significant mineral occurrences are also associated with peridotite bodies intruding small anorthositic complexes, or with mineralized pyroxenite dykes injected in peridotitic stocks or late-tectonic mafic and ultramafic intrusions that cut metamorphosed supracrustal sequences (Hébert, 1997; Clark and Hébert, 1998a and 1998b).

In 2004, **Matamec Explorations Inc.** (project 2, Figure 1E-1) delineated several EM anomalies, the largest measuring 700 m long by 100 m wide, on the Vulcain property, which hosts the Renzy deposit. Inferred mineral resources for the latter were recently estimated at 259,000 tonnes at 0.72% Ni and 0.94% Cu. The Renzy deposit, which was mined by open pit from 1969 to 1972, is hosted in tabular ultramafic intrusions injected in a metasedimentary sequence possibly associated with the Central Metasedimentary Belt.

In La Trappe Township, near Lac Yénévac, company **9141-6883 Québec Inc.** (project 10, Figure 1E-1) and prospector **Lionel Lefebvre** (project 11, Figure 1E-1) uncovered a copper-nickel showing associated with a norite facies in the Lac-Saint-Jean anorthositic Suite. Surface stripping exposed a massive sulphide lens of 100 m long by about 4 to 5 m wide, with grades up to 1% Cu and 1% Ni.

Eastern Grenville Province

In 2004, exploration was focussed on the search for copper, nickel, and platinum group elements (PGE) as well as industrial minerals (graphite and titanium). The Manicouagan MRC was once again the focus of intense exploration by many junior

companies and individual prospectors. Following through on its Grenville Project, **Géologie Québec** prepared a geological mapping survey at 1:50,000 scale in NTS sheet 22 F/10.

MAGMATIC NI-CU (CO-PGE) DEPOSITS

About 20 km NNE of Daniel-Johnson dam (Manic-V), **Quinto Technology Inc.** actively explored the Lac Paradis showing (project 15, Figure 1E-1), and reported grades ranging from 0.27 to 4.75% Ni and from 0.04 to 2.4% Cu. **Géologie Québec** assayed a massive sulphide sample from this showing, and obtained grades of 5.26% Ni and 0.03% Cu with low PGE concentrations.

Manicouagan Minerals Inc. reported grades ranging from 0.01 to 0.13% Ni and from 0.11 to 1.11% Cu, with trace amounts of Pt, Pd, and Au, from drillholes testing two gossans and some electromagnetic anomalies on the Baie du Nord project (project 16, Figure 1E-1). The company is exploring within the confines of the Manicouagan meteorite impact crater, hoping to discover Sudbury-type Ni-Cu deposits.

IRON FORMATIONS

The Fermont area is characterized by the presence of abundant iron ore deposits, mined since the 1950s by the **Québec Cartier Mining Company** in Québec, and by **IOC** and **Wabush Mines** in Labrador. These ore deposits are part of the Gagnon Group and represent the Grenvillian metamorphic equivalents of iron formations in the Labrador Trough. Extracted minerals include hematite and specular hematite. Renewed interest in iron ore prompted several companies to acquire options on known magnetite-rich deposits.

MAGMATIC MASSIVE ILMENITE DEPOSITS

QIT-Fer et Titane Inc., a wholly-owned subsidiary of the Anglo-Australian **Rio Tinto** Group, operates, since 1950, an open pit mine to extract ilmenite at Lac Tio (Figure 1E-1) near Havre-Saint-Pierre, as well as a metallurgical complex in Sorel-Tracy, where the ore is processed to produce titanium dioxide, pig iron, and high-quality steel. The Lac Tio ore deposit is the second largest in the world, with proven reserves of 75 Mt at an average grade of 86.9% combined iron and titanium oxide (34.2% TiO_2, 27.5% FeO, 25.2% Fe_2O_3; 4.3% SiO_2, 3.5% Al_2O_3, 3.1% MgO, 0.9% CaO, 0.1% Cr_2O_3, 0.41% V_2O_5). In 2004, **QIT-Fer et Titane Inc.** and **Rio Tinto Fer et Titane Inc.** carried out extensive work including geophysical surveys, in order to define drilling targets in the Havre-Saint-Pierre anorthositic Suite (projects 17, 18, and 19, Figure 1E-1).

In partnership with **Sheridan Platinum Group Ltd**, **Fancamp Exploration Ltd** discovered new hemo-ilmenite outcrops on the Mingan Titanium Option property (project 20, Figure 1E-1).

Quinto Technology Inc. (project 21, Figure 1E-1) intersected 24.69 m of massive hemo-ilmenite in drillhole on the Lac Brûlé property in the Labrieville anorthositic Suite, about 100 km northwest of Forestville. Analyses of two surface grab samples yielded the following results: 34.80-34.30% TiO_2, 60.70-60.20% Fe_2O_3, 1.36-1.46% Al_2O_3, 1.78-1.38% MgO, 0.13% MnO, 0.22-0.29% CaO, 0.08-0.07% Cr, 0.07-0.30% P_2O_5, and 0.19% V. The objectives of the 2004 drill program were to delineate reserves in this deposit, where an estimated 6.5 Mt of indicated resources and 3.5 Mt of inferred resources were delineated in the 1950s by **Bersimis Mining Corp.** for two of the three massive hemo-ilmenite lenses (A, B, and C).

Opportunities for Exploration

With uranium prices on the rise over the past two years, certain parts of the Grenville Province have attracted the attention of companies engaged in uranium exploration. Based on airborne gamma ray spectrometry compilation maps released by the Geological Survey of Canada (GSC Open File 4460), three strongly anomalous areas are outlined: the Mont-Laurier area, an area northwest of Gatineau, and the Lac Litchfield area. While the uranium potential of the Gatineau and Litchfield areas is associated with granitic and syenitic intrusions, the potential of the Mont-Laurier area appears to be associated with the formation of the Mont-Laurier sedimentary basin in the Central Metasedimentary Belt, or with the tectonometamorphic remobilization of uranium during Grenvillian metamorphism. Other areas such as the Wakeham sedimentary basin and the granitic Lac Turgeon pluton in the Moyenne Côte-Nord region are also targets to be considered.

Recent mapping by the **Géologie Québec** in the Lac Varin area (NTS 22 F/10; Gobeil *et al*., 2004) outlined the great mineral potential of this area. Several types of mineral occurrences (magnetite and ilmenite, apatite, and sulphides) and potential architectural stone varieties were identified during this geological mapping survey. This area is certainly worth a second look in terms of its exploration potential associated with an anorthositic suite composed of anorthosite, leuconorite, troctolite, gabbronorite, and mangerite. The Moyenne-Côte-Nord region, and especially the Lac Caron area (NTS 12 L/07, L/08 and L/09), constitutes a prospective area to rediscover, with Mesoproterozoic rocks of the Wakeham Terrane. Several Cu-Au-Ag (*e.g.* BJB, Lac Véronique) and Ni-Cu (*e.g.* Nord de la crête White; Clark, 1995) showings and occurrences are known and documented from previous prospecting campaigns, field studies and geological mapping. The Lac Caron area contains the km-wide Lac Caron shear zone, which extends for about 75 km along strike. It is a brittle-ductile deformation zone characterized by the emplacement of a series of pegmatite sills and quartz veins (Nadeau *et al.*, 2004). These sills and veins may have acted as discharge zones and constitute an interesting ore guide for gold deposits. The shear zone is hosted in metagabbros of the Robe-Noire Suite, which should be the focus of a very detailed sampling program for PGE analyses.

1E

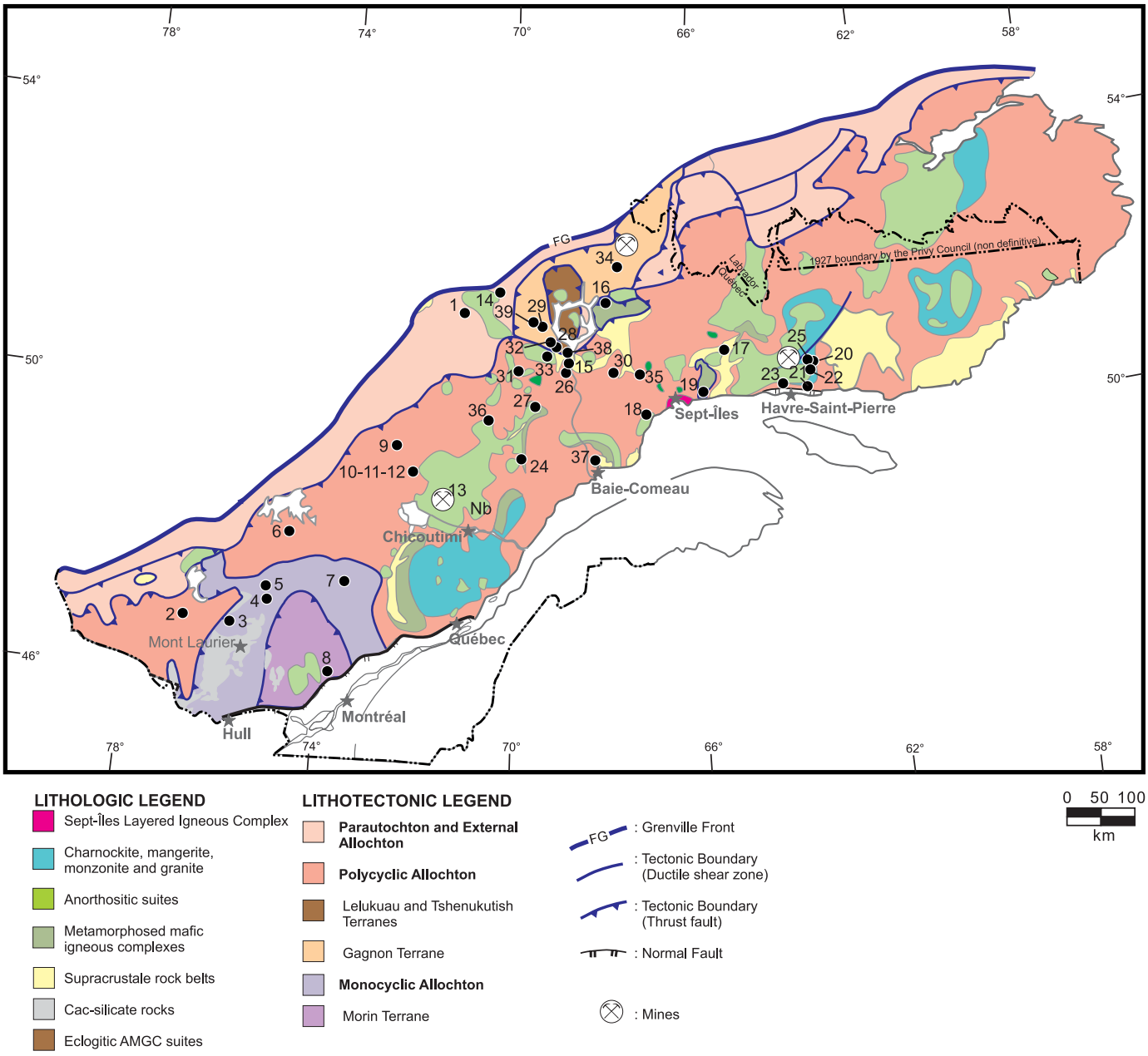

Figure 1E-1. Exploration projects in the Grenville Province for 2004.

TABLEAU 1E-1 - Exploration projects in the Grenville Province for 2004 (see figure 1E-1).

NO	TOWNSHIPS	NTS	COMPANIES / PROSPECTORS	PROJECTS	SUBSTANCES	WORKS [1]
1	-	21 M, 22 D, 22 F, 22 N, 23 C, 31 O, 31 N	Virginia Gold Mines Inc. / BHP Billiton	Reconnaissance Grenville	Cu-Ni-Co-PGE	G, Pr
2	Hainaut	31 K/15	Matamec Explorations Inc.	Vulcain	Ni-Cu	AEROTEM, Re
3	Major	31 J/12, 13	Exploration Esbec Inc.	Cran Bornite	Cu-Au-Ag	Gs(r), Pg, T
4	-	31 O/03	Ressources Maxima Inc.	Montagne d'argent	Cu-Au	Gs(r), Pg
5	-	31 O/06	Ressources Maxima Inc.	Le Sueur	Cu	Pg
6	Tassé, Bazin	31 O/15, 32 B/02	Prospection Minordbec	Abeille	Cu-Ni-PGE	G, T
7	-	31 P/06, 11, 12, 13	G. Gingras	-	-	S, T
8	Kildare	31 I/04	M. Lazarescu / M. Bercaru	-	Au-Cu-Ag	D(1:20), S
9	Desautels	32 H/06	9083-5596 Québec Inc.	Lac Desautels	Ni-Cu-Co	D(12:8000)
10	La Trappe	32 H/01	9141-6883 Québec Inc.	Lac Yenevac	Ni-Cu	T
11	La Trappe	32 H/01	L. Lefebvre	Lac Yenevac	Ni-Cu-Co	T
12	Melançon	32 H/01	J.-L. Tremblay / L. Lefebvre	Stanislas	Ni-Cu-Co	D(3:1), S, T
13	Simard	22 D/11	Cambior Inc.	Niobec	Nb	D(?:9211)
14	-	22 M/15	Bitterroot Resources Ltd	Mistassini	Ni-Cu-PGE	D(8:1714), EM, G, S
15	-	22 K/15	Quinto Technology Inc. / SOQUEM INC.	Lac Paradis	Cu-Ni	G, Gp, Pr, S
16	Quertier, Brien	22 N/09	Manicouagan Minerals Inc.	Baie du Nord	Cu-Ni-Co-PGE	D(4:400), EM, S
17	-	22 I/14	Cuesta Geoscience Inc. / Pacific North West Capital Corp.	Lac Manitou PGM	Ni-Cu-PGE	G, S
18	Grenier	22 G/14, 22 J/03	Ressources Appalaches Inc. / Marum Resources Ltd	B-20	Cu-Ni-Co	EM, G, Mag, Pr
19	Moisie	22 I/05	Ressources Appalaches Inc. / Fancamp Exploration Ltd	Lac Méchant	Cu-Ni-Co	Grav
20	Parker	12 L/11	QIT-Fer & Titane Inc.	Grader South	Fe-Ti	Gg(A), Grav, S
21	Cugnet	12 L/05	QIT-Fer & Titane Inc.	Scherrer-Picard	Fe-Ti	EM, TDEM
22	Vigneau	12 L/05	Rio Tinto Fer & Titane Inc.	Big Island	Fe-Ti	Gg(A), S
23	Mingan	22 I/08	Fancamp Exploration Ltd / Sheridan Platinum Group Ltd	Mingan	Fe-Ti	G, S, T
24	-	22 F/05	Quinto Technology Inc.	Lac Brûlé	Fe-Ti	B(10:?), D(12:?), Pr
25	Parker	12 L/11, 12	QIT Fer & Titane Inc.	Grader West	Fe-Ti	Gg(A), Grav, S

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NO	TOWNSHIPS	NTS	COMPANIES / PROSPECTORS	PROJECTS	SUBSTANCES	WORKS [1]
26	-	22 K/10, 15	Fancamp Exploration Ltd	Manicouagan	Cu-Ni-Co	G, Pr, S
27	-	22 K/03, 04, 05, 06	Gowest Amalgamated Resources Ltd	Quebec Nickel	Cu-Ni-Co	AEROTEM, Mag
28	-	22 N/03	Ressources Appalaches Inc.	Lamentshiu	Cu-Ni-Co	G, Pr
29	-	22 N/06	Ressources Appalaches Inc.	Manic-Ouest	Cu-Ni-Co	Pr
30	-	22 J/12	Puma Exploration Inc.	Aimé	Rare Earths	Pr
31	-	22 K/12	Puma Exploration Inc.	Lac à l'Argent	Cu-Ni-Co	Pr
32	-	22 N/03	Quinto Technology Inc. / SOQUEM INC.	Lac Guéret	GP	G, S, T
33	-	22 N/03	Quinto Technology Inc. / SOQUEM INC.	Lac Guéret sud	Ni-Cu-PGE-GP	G, S, T
34		23 B/05	E. D. Black / Quinto Technology Inc.	Peppler Lake	Fe	Pr, S
35	-	22 J/10	Exploration Esbec Inc.	Ste-Marguerite	Cu-Ni-Co-PGE	D(3:250), Gs(sl), Mag, Pr
36	-	22 F/13	Exploration Esbec Inc.	B-100	Cu-Ni	Pr, S
37	-	22 G/05, 22 F/08	Exploration Minière Manicouagan	Manicouagan Area	Ni-Au	EM, Mag, Pr, S
38	-	22 N/03	Exploration Minière Manicouagan	Manicouagan Area	Ni-Cu	EM, Mag, Pr, S
39	-	22 N/05	Exploration Minière Manicouagan	Manicouagan Area	Ni-Cu-Au	EM, Mag, Pr, S

1 = See abbreviation list in appendix II.