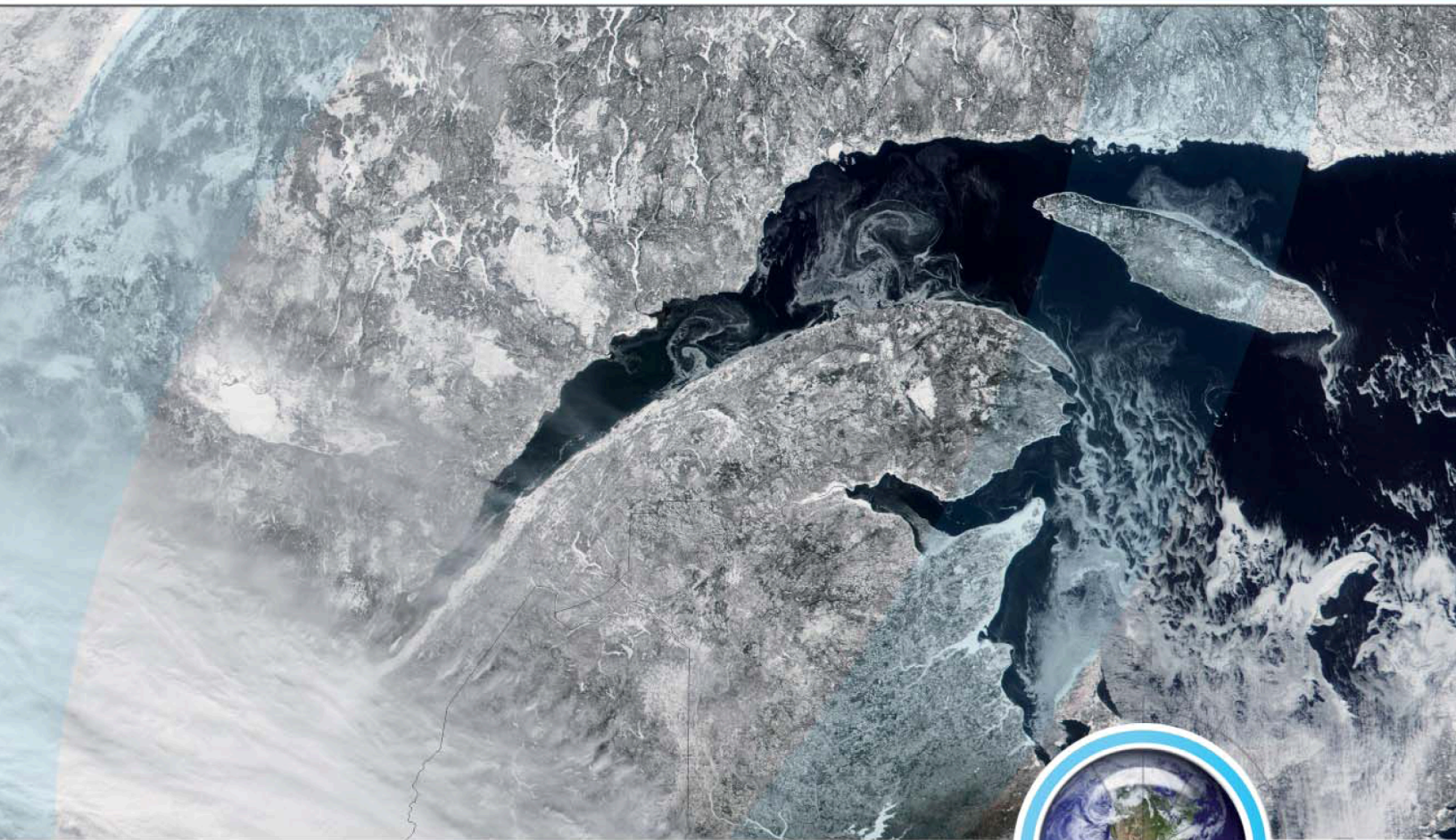


PRO 2008-02



Yves Bellemare



# New exploration targets for architectural stone

Québec 

# NEW EXPLORATION TARGETS FOR ARCHITECTURAL STONE

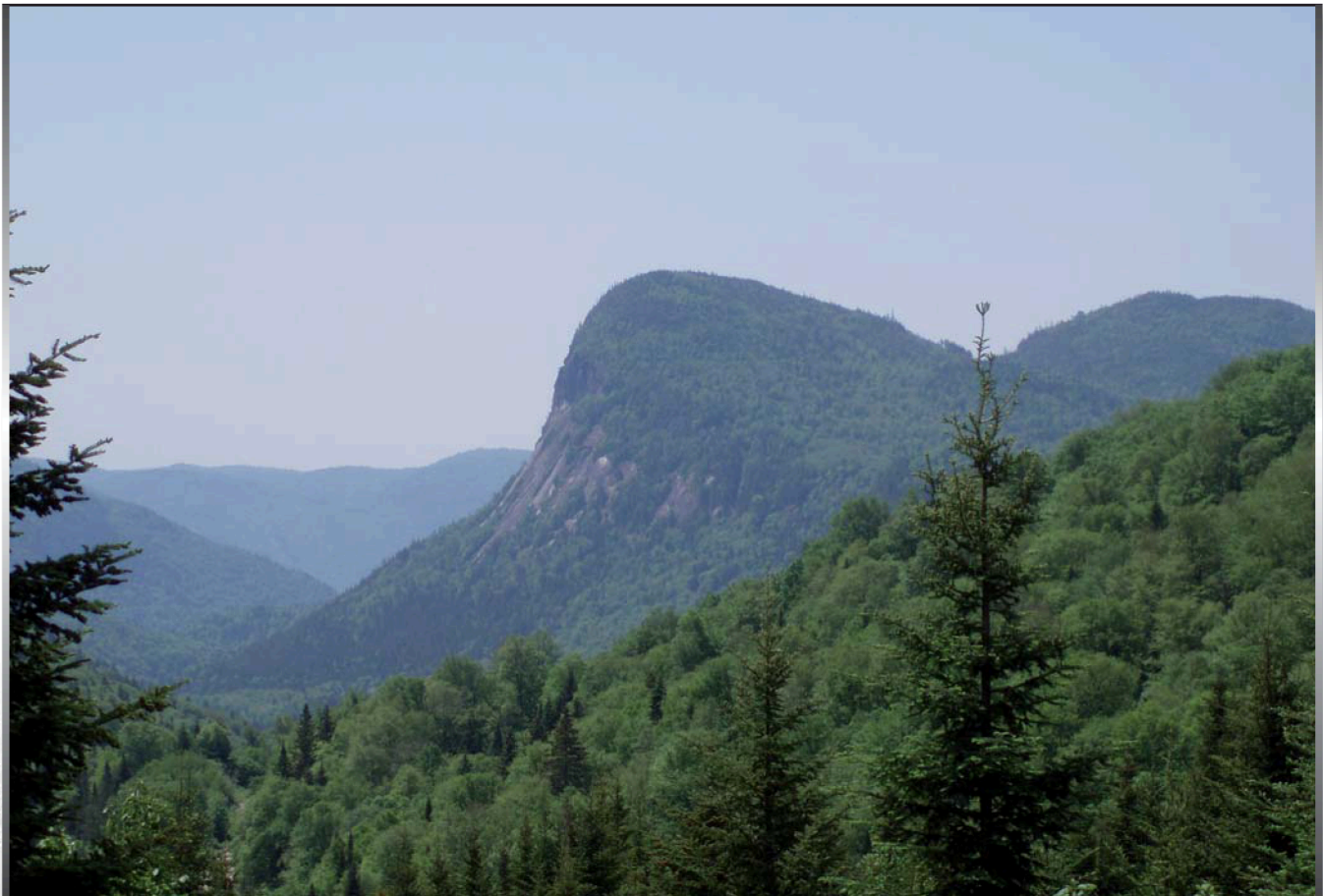
**PRO 2008-02**

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**Keywords:** stone, architectural, monumental, ornamental, exploration

Fieldwork was conducted in the summer of 2007 by the Ministère des Ressources naturelles et de la Faune (MRNF) in order to assess the potential for architectural stone (which includes monumental stone and ornamental stone) in four regions of Québec: Côte-Nord – Charlevoix, Bas-Saint-Laurent, Portneuf MRC, and Saguenay – Lac-Saint-Jean. During this work, the physical and aesthetic characteristics of unexploited lithological units were determined and prospective sites warranting further investigations were delineated.

By definition, an exploration target exhibits favourable geological features that justify conducting more detailed exploration work in the search for commodities in new or well established areas. The exploration targets defined herein are regional in scale, given that the recommended area of investigation around each target is kilometre-scale. UTM coordinates provided in the tables indicate the geographic centre of each target.



Typical topographic relief in the west part of NTS 21M04, Portneuf MRC.

## Côte-Nord and Charlevoix

In these regions, our work focused mainly on outcrops of red leptynite (quartzofeldspathic gneiss), red granitic gneiss with minor biotite and to a lesser extent, augen gneiss of the Saint-Paul-du-Nord Formation. These outcrops were examined to determine their potential for dimension stone.

According to Rondot (1986), the upper member of the Saint-Paul-du-Nord Formation exhibits a strong foliation



Waterfall on the Rivière du Sault-au-Mouton

and is mainly composed of biotite-poor (< 5%) leptynite and granitic gneiss with 5 to 15% biotite. The upper member is characterized, in particular, by the presence of a few layers of grey biotite gneiss and the scarcity of amphibolite. To the north of Forestville (NTS sheet 22C14), Genest (1995) also mapped granitic gneiss units with a minor biotite content, which were assigned to unit 3 of the Forestville metamorphic Suite. However, the latter units described by Genest were not examined within the scope of this project.

In 2002, assessment work was performed in a restricted area located north of Saint-Paul-du-Nord (Bellemare et al., 2002). In 2007, most outcrops in the Saint-Paul-du-Nord Formation that were accessible by logging roads between Forestville and Saint-Siméon were mapped. The area showing the best potential is located in NTS sheet 22C11, where six new regional exploration targets were defined (Table 1). Further exploration work will be needed to fully assess the potential of these units.

Defined exploration targets exhibit a few common features. Potential leptynite, granitic gneiss and augen gneiss outcrops occur along elongate topographic ridges with gentle slopes, with the exception of the Lac des Cèdres target area, where topographic relief is significant (Photo 1). Overall, the weathering rind of targeted lithological units is mm-thick, except for outcrops near Lac Brumbell, where it is cm-thick.

Leptynites commonly display a reddish pink, greyish pink, or red colour (Photo 2). The grain size may vary on a local scale, which constitutes their main flaw. The rock takes on a beautiful polish thanks to its fine-grained nature

and its low biotite content. The thickness of leptynite units is somewhat limited, which may reduce their potential.

Granitic gneisses look quite plain due to their high biotite content and their greyish colour. Near Lac de la Grosse Truite (Target 3), their sharper reddish hue and their evenly banded texture make them more attractive.

Potential assessment work on augen gneisses, assigned by Rondot to the Saint-Paul-du-Nord Formation, was limited. These gneisses display a greyish pink colour and a distinctive banded texture (Photo 3). Polishing tests did not yield good results since sawn samples did not have even fresh surfaces. They were observed in two areas in NTS sheet 22C11 (targets 4 and 6).

In 2007, assessment work on leptynite and granitic gneiss units of the Saint-Paul-du-Nord Formation failed to locate outcrops of the same quality as those found in 2002. The favourable geological attributes of newly defined exploration targets are sufficient to garner interest, however additional work will be needed to establish their true potential.

## Bas-Saint-Laurent

Assessment work in this region focused on the potential of sandstones and conglomerates of the Robitaille Formation for the production of masonry stone, flagstone, ornamental stone, and decorative aggregate. In 2001, multicoloured sandstones of the Robitaille Formation exposed near Saint-Mathieu-de-Rioux were examined for their potential for architectural stone (Bellemare and Jacob, 2001). In 2007, we continued the potential assessment of the Robitaille Formation in other areas where this unit had been mapped, between Rimouski and Cabano.

The type section for the Robitaille Formation is located northeast of Canano and was described by Lespérance and Greiner (1969). Here, the formation is largely composed of grey sandstone, red and green siltstone, grey quartzite and grey limestone. In areas further north, for example near Saint-Guy, geological mapping conducted by SOQUEM (Gauthier, 1999) revealed the presence of conglomerate beds and grey or red quartz sandstone layers. Assessment work performed in 2007 yielded its most promising results near Saint-Guy (NTS sheet 22C02) and La Résurrection (boundary between map sheets 21N10 and 21N11), where three regional targets were defined (Table 2).

Within the Saint-Guy municipality limits, we found evidence of former rudimentary extraction sites. These are most likely the same as work reported by Maurice (1973, p. 430). The targeted stone consists of reddish pink quartz sandstone in massive beds from 0.3 to 0.6 m thick and dipping at 35 to 45°. This sandstone may be suitable to produce masonry stone, however the outcrops are now located too close to exploited areas to consider quarry operations in this location.

Two exploration targets were nevertheless defined to the northeast of Saint-Guy. In an area west of Lac Branch (Target 7), beds of red quartz sandstone and conglomerate from 0.3 to

0.6 m thick may be suitable to produce masonry stone and decorative aggregate. The beds are steeply dipping however, on the order of 35 to 45° (Photo 4). The conglomerate unit, composed of cobbles and pebbles of white quartz, chert and volcanic rock in a quartz sandstone matrix (Photo 5), may also constitute an interesting ornamental stone. In the same area, southeast of Lac Cyprien, beds of red or mottled (red and white) quartz sandstone of the Robitaille Formation are generally 4 to 12 cm thick and dip at about 45° (Photo 6). Beds split easily along exposed surfaces. This stone may be suitable to produce flagstone or decorative aggregate.

The second target is located northwest of Lac à Florient (Target 8), where beds of red conglomerate more than 0.3 m thick and dipping at about 45° were observed. The latter are similar to those near Lac Branch, however the terrain here is characterized by gently rolling topography.

At La Résurrection, near Lac du Chat, Morin (1985) mapped units of white quartz sandstone and pinkish grey conglomerate tentatively assigned to the Robitaille Formation. The conglomerate weathers to an orange colour and beds range from 0.3 to 1.0 m in thickness. This area requires further exploration work to fully assess its potential for flagstone and ornamental stone.

The vast majority of quartz sandstone outcrops of the Robitaille Formation examined in 2007 are not as suitable

for exploitation as those in the Saint-Mathieu-de-Rioux area. In many locations, sandstone units are interbedded with mudstones or limestones. Moreover, red sandstone units are generally relatively thin and dip at about 45°. Also, outcrops in potential areas mostly occur in gently rolling terrain. Units of red conglomerate may be explored for use as ornamental stone, but like the sandstone units, they show greater potential for the production of flagstone and decorative aggregate, essentially due to the fact that conglomerate and sandstone beds are relatively thin, rarely exceeding 0.3 m in thickness.

## Portneuf MRC

In the Portneuf MRC, fieldwork was conducted to determine the potential in certain parts of NTS sheets 21M04 and 21M05, where massive outcrops and blocks larger than a few tens of cubic metres (Photo 7) were found during a geological mapping survey conducted in 2006 (Hébert and Bellemare, 2007). Our assessment focused on dark rocks of the Rivière-à-Pierre plutonic Suite, exhibiting various shades of blackish grey or greenish grey (unit mPrr2a), dioritic and tonalitic orthogneisses of the La Bostonnais

Saint-Mathieu-de-Rioux area



Complex (unit mPbos) and augen gneisses of the Tourilli Pluton (unit mPcp12).

Dark rocks of the Rivière-à-Pierre plutonic Suite were examined in the north and west parts of NTS sheet 21M04 and the south part of NTS sheet 21M05. In terms of mineralogical composition, they can be classified as orthopyroxene and clinopyroxene-bearing monzodiorites, monzonites, or monzogranites. They contain porphyroid feldspar phenocrysts and commonly exhibit a variety of shades and textures in different locations (Photo 8). Due to these features, these rocks are distinct from rocks quarried near Rivière-à-Pierre. During assessment work conducted in 2007, the massive aspect of outcrops was highlighted, a few exploration targets were defined (targets 10 to 16), and the relevance of



Lac Dufresne. East part of NTS 21M04

performing further exploration work on rocks of unit mPrr2a was confirmed.

Augen-textured rocks of the Tourilli Pluton were examined in one area only, near Lac Potvin (Target 17). In 2006, no massive outcrops were found along logging roads or trails. In 2007, traverses in wooded areas were successful in locating massive outcrops under an ever-present plant cover.

The monzogranite is pinkish grey in fresh surface and orangey pink in weathered surface (Photo 9). The weathering rind is quite thick, measuring up to 10 cm. It proved a hindrance for polishing tests and made it impossible to adequately determine the aesthetic quality of this augen-textured monzogranite.

Despite the encouraging aspect of outcrops found during geological mapping conducted in 2006, rocks of the La Bostonnais Complex contain too many detrimental elements or else outcrops appear to be too small to justify further potential assessment work.

In summary, many of the outcrops that were examined displayed a massive aspect. Rocks of the Rivière-à-Pierre plutonic Suite and the Tourilli Pluton show attractive shades and textures and contain few detrimental elements. Targets described in Table 3 constitute a preliminary assessment of the potential for dimension stone in NTS sheets 21M04 and 21M05.

## Saguenay – Lac-Saint-Jean

The search for exploration targets took place within the scope of a pilot project aimed at producing thematic mineral potential assessment maps for many different resources (metallic deposits, industrial minerals, architectural stone, unconsolidated deposits, and peat). For architectural stone, efforts were concentrated in NTS sheets 32A and 32H. New exploration targets were defined, mainly in the south part of NTS sheet 32A (Table 4, targets 18 to 21). Targets for dimension stone near Lac de la Cabane (Target 19) and Lac Touladi (Target 22) were discovered by Claude Hébert and Jean-Yves Labbé during potential assessment work for metallic substances.

Work performed in this area confirmed the low potential for dimension stone in ultramafic rocks, paragneisses, amphibolites, quartzites, marbles and most gabbros, migmatites and gneisses. The potential is greater in rocks of anorthositic suites (black, blue and violet granite), charnockitic suites (green and brown granite), and granitic suites (pink and red granite). In particular, an extensive area located east of Lac Bouchette and mapped by Benoit and Valiquette (1971, p. 15), and another area located in the southwest part of NTS sheet 32A (Laurin, 1995) host significant exploration targets. Outcrops are generally massive (Photo 10) and rocks of charnockitic and granitic suites display aesthetic qualities similar to those occurring in the Rivière-à-Pierre area (targets 20 and 21).

In an area southwest of NTS sheet 22E04, Gervais (1993a and 1993b) mapped pink to orange-coloured, augen-textured and strongly foliated farsundites containing 60% rapakivi feldspar phenocrysts, with 20 to 25% quartz, biotite, and



Straight gneiss along Highway 190 north of Sagard

hornblende. This farsundite is a facies of the Patrick Ouest Charnockite (Hébert et al., in preparation), which is part of the Lac-Saint-Jean anorthositic Suite. Gervais also reported the presence of foliated gabbros cut by discontinuous faults marked by the presence of ultramylonites. Both augen textures and ultramylonites are related to the Pimuaican Deformation Zone (Hébert, 1999), which crosscuts rocks of the Lac-Saint-Jean anorthositic Suite in this area. Along

the southwest extension of the Pimpuacan Deformation Zone, the same geological setting occurs in the northwest part of NTS sheet 22D13 and the northeast part of NTS sheet 32A16. Potential assessment work was conducted near Lac Labrecque, to the west of Saint-Ludger-de-Milot (NTS sheet 22D13). The results indicate that although rocks in mylonite zones in this area are very aesthetic, they would be difficult to exploit in the current context. They exhibit significant planes of weakness that hinder the extraction of large blocks. Within the same area, a relatively massive augen-textured mangerite was observed, but it contains too many detrimental elements in this location for commercial extraction purposes (Photo 11). Given the aesthetic quality of augen-textured farsundites or mangerites, the entire area

within NTS sheets 22D13, 22E04 and 31A16 should be the focus of a regional exploration program.

The potential for flagstone is well established for limestones near Saint-Honoré (NTS sheet 22D06) and should be assessed for calc-silicate marbles (Photo 12) and certain varieties of migmatite and straight gneiss. In addition to white marbles from the Mistassini area (NTS sheet 32A16), which have been quarried since the early 1930s, the potential for decorative aggregate should be examined for salmon pink monzonite or syenite in the Rivière-aux-Rats ZEC (Berrangé, 1959, p. 9; Berrangé, 1960, p. 8), for red granite along both shores of Rivière Péribonka (Hébert and Cadieux, 2002), and for diabase, particularly those occurring west of Saint-Ludger-de-Milot (Béland, 1967).

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NEW EXPLORATION TARGETS FOR ARCHITECTURAL STONE			
Name of target	Location (UTM NAD 83)	NTS	Comments
<b>EXPLORATION TARGETS IN THE CÔTE-NORD AND CHARLEVOIX REGIONS</b>			
(1) Lac Noir	<b>Zone 19</b> 481954 m E 5397106 m N	22C11	Red, fine-grained leptynite containing less than 2% biotite. Local variations in grain size and pockets of pegmatite.
(2) Petite rivière Noire	<b>Zone 19</b> 489835 m E 5393550 m N	22C11	Red, medium-grained leptynite. Gently rolling terrain and limited surface area. A few pockets of pegmatite.
(3) Lac de la Grosse Truite	<b>Zone 19</b> 479148 m E 5385496 m N	22C11	Reddish pink or red, fine to medium-grained, banded granitic gneiss containing about 5% biotite. Uniform texture.
(4) Lac des Cèdres	<b>Zone 19</b> 476638 m E 5385361 m N	22C11	Pink, coarse-grained augen gneiss containing 10% biotite. Strong topographic relief.
(5) Lac Brumbell	<b>Zone 19</b> 467451 m E 5376997 m N	22C11	Reddish or greyish pink, fine-grained leptynite containing less than 5% biotite. The weathering rind is fairly thick (2.5 cm).
(6) Lac du Deux milles	<b>Zone 19</b> 476633 m E 5377039 m N	22C11	Reddish pink or red, fine-grained leptynite containing less than 5% biotite, and reddish pink, coarse-grained augen gneiss. Locally uniform texture.
<b>EXPLORATION TARGETS IN THE BAS-SAINT-LAURENT REGION</b>			
(7) Lac Branch	<b>Zone 19</b> 517274 m E 5324431 m N	22C02	Red quartz sandstone and conglomerate. Beds dip from 35 to 45 degrees. Extensive area with strong topographic relief.
(8) Lac à Florient	<b>Zone 19</b> 515417 m E 5322079 m N	22C02	Red conglomerate. Gently rolling terrain and beds dipping at about 45 degrees.
(9) Lac du Chat	<b>Zone 19</b> 499170 m E 5266138 m N	21N11	Pinkish grey conglomerate with an orangey red weathered surface. Beds dip from 20 to 35 degrees. Strong topographic relief.

**NEW EXPLORATION TARGETS FOR ARCHITECTURAL STONE (CONTINUED)**

Name of target	Location (UTM NAD 83)	NTS	Comments
<b>EXPLORATION TARGETS IN THE PORTNEUF MRC</b>			
(10) Lac Rougon	<b>Zone 19</b> 284597 m E 5237397 m N	21M05	Pinkish grey, coarse-grained porphyroid quartz mangerite of the Rivière-à-Pierre plutonic Suite. Dimension stone.
(11) Lac Nollen	<b>Zone 19</b> 287839 m E 5240364 m N	21M05	Orangey pink, brownish grey or greenish grey, coarse-grained porphyroid farsundite of the Rivière-à-Pierre plutonic Suite. Dimension stone.
(12) Lac Dalila	<b>Zone 19</b> 274473 m E 5217916 m N	21M04	Greenish grey, coarse-grained porphyroid quartz mangerite of the Rivière-à-Pierre plutonic Suite. Dimension stone.
(13) Lac de la Hauteur	<b>Zone 19</b> 278001 m E 5217707 m N	21M04	Greenish grey, coarse-grained porphyroid quartz mangerite of the Rivière-à-Pierre plutonic Suite. Dimension stone.
(14) Lac Drucilla	<b>Zone 19</b> 279250 m E 5230338 m N	21M04	Greenish grey, coarse-grained jotunite of the Rivière-à-Pierre plutonic Suite containing 1 to 10-cm porphyroclasts of black plagioclase. Dimension stone.
(15) Lac William	<b>Zone 19</b> 278506 m E 5231651 m N	21M04	Greenish grey porphyroclastic farsundite of the Rivière-à-Pierre plutonic Suite. Similar to the Atlantic Green variety. Dimension stone.
(16) Lac Sirois	<b>Zone 19</b> 278909 m E 5209697 m N	21M04	Coarse-grained mangerite or jotunite of the Rivière-à-Pierre plutonic Suite, probably green-coloured. Dimension stone.
(17) Lac Potvin	<b>Zone 19</b> 304312 m E 5230055 m N	21M04	Pinkish grey, coarse-grained augen gneiss of the Tourilli Pluton. The weathered surface is orangey pink. Dimension stone.
<b>EXPLORATION TARGETS IN THE SAGUENAY – LAC-SAINT-JEAN REGION</b>			
(18) Rivière Brûle-Neige	<b>Zone 19</b> 305534 m E 5489786 m N	22E12	Violet anorthosite of the Lac-Saint-Jean anorthositic Suite. Dimension stone.
(19) Lac de la Cabane	<b>Zone 19</b> 371644 m E 5518369 m N	22E15	Violet anorthosite of the Lac-Saint-Jean anorthositic Suite. Dimension stone.
(20) Lac Ouitouche	<b>Zone 18</b> 719064 m E 5343908 m N	32A01	Orangey red or pinkish grey porphyroid granite or quartz monzonite. Dimension stone.
(21) Lac des Grandes Gueules	<b>Zone 18</b> 646217 m E 5359353 m N	32A06	Green, coarse-grained porphyroid rock of the charnockitic suite, weakly foliated. Dimension stone.
(22) Lac Touladi	<b>Zone 18</b> 671079 m E 5371211 m N	32A07	Coarse-grained porphyroid rock of the charnockitic suite. Dimension stone.
(23) Lac à Boucher	<b>Zone 18</b> 715849 m E 5353824 m N	32A08	Pinkish grey, coarse-grained porphyroid granite. Uniform texture. Gently rolling terrain. Dimension stone.
(24) Lac du Brochet	<b>Zone 18</b> 691416 m E 5501023 m N	32H09	Greyish pink, fine-grained granite, uniform texture. Dimension stone and flagstone.

NOTE – Coordinates indicate the geographic centre of each target. Outcropping areas that were assessed are included within the km-scale radius of these targets but their precise location may be different from the UTM coordinates provided in these tables.



**PHOTO 1** - Target 4, Lac des Cèdres. Massive outcropping zone in an area with strong topographic relief (NTS 22C11; NAD 83, zone 19, 477088 m E, 5385167 m N).



**PHOTO 2** - Target 6, Lac du Deux Milles. Reddish pink, fine-grained leptynite of the Saint-Paul-du-Nord Formation (NTS 22C11; NAD 83, zone 19, 478038 m E, 5377366 m N).



**PHOTO 3** - Target 4, Lac des Cèdres. Pink, coarse-grained augen gneiss containing 10% biotite of the Saint-Paul-du-Nord Formation (NTS 22C11; NAD 83, zone 19, 477088 m E, 5385167 m N).



**PHOTO 4** - Target 7, Lac Branch. Red quartz sandstone and conglomerate in beds from 0.3 to 0.6 m thick (NTS 22C02; NAD 83, zone 19, 517396 m E, 5324797 m N).



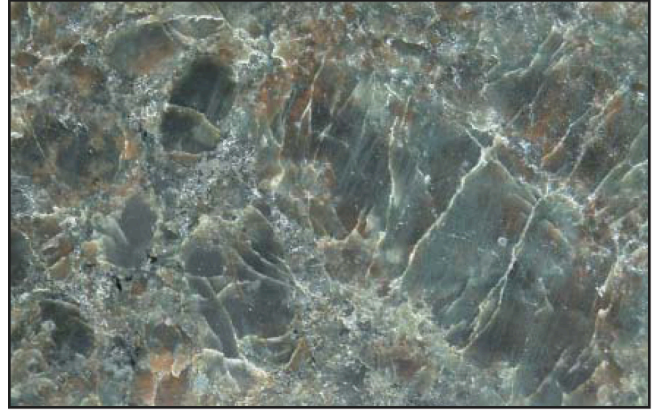
**PHOTO 5** - Target 7, Lac Branch. Red conglomerate of the Robitaille Formation (NTS 22C02; NAD 83, zone 19, 517396 m E, 5324797 m N).



**PHOTO 6** - Target 7, Lac Branch. Thin beds of red or mottled (red and white) quartz sandstone from 4 to 12 cm thick, underlying a 0.3-m thick bed (NTS 22C02; NAD 83, zone 19, 517702 m E, 5325596 m N).



**PHOTO 7** - Target 10, Lac Rougon. Metre-scale block of pinkish grey, coarse-grained porphyroid quartz mangerite of the Rivière-à-Pierre plutonic Suite (NTS 21M05; NAD 83, zone 19, 285115 m E, 5237025 m N).



**PHOTO 8** - Target 14, Lac Drucilla. Greenish grey, coarse-grained jotunite of the Rivière-à-Pierre plutonic Suite, containing 1 to 10-cm porphyroclasts of bluish black plagioclase (NTS 21M04; NAD 83, zone 19, 279250 m E, 5230338 m N).



**PHOTO 9** - Target 17, Lac Potvin. Weathered surface of augen-textured monzogranite in the Tourilli Pluton (NTS 21M04; NAD 83, zone 19, 304214 m E, 5230690 m N).



**PHOTO 10** - Target 21, Lac des Grandes Gueules. Massive outcrop (NTS 32A06; NAD 83, zone 18, 646446 m E, 5359820 m N).

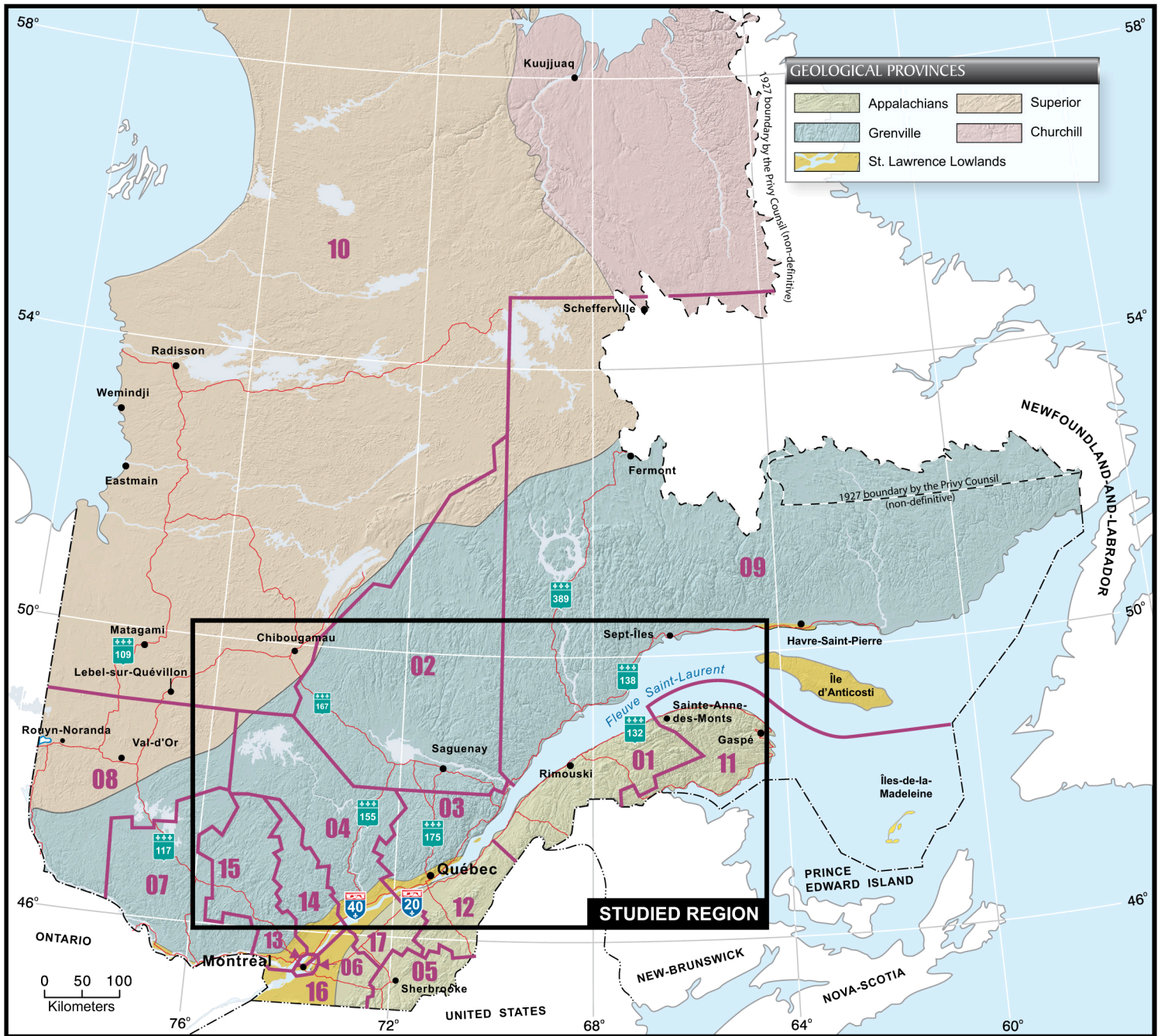


**PHOTO 11** - Lac Labrecque. Orangey pink augen-textured mangerite with a high content of detrimental elements (NTS 22D13; NAD 83, zone 19, 282339 m E, 5423497 m N).



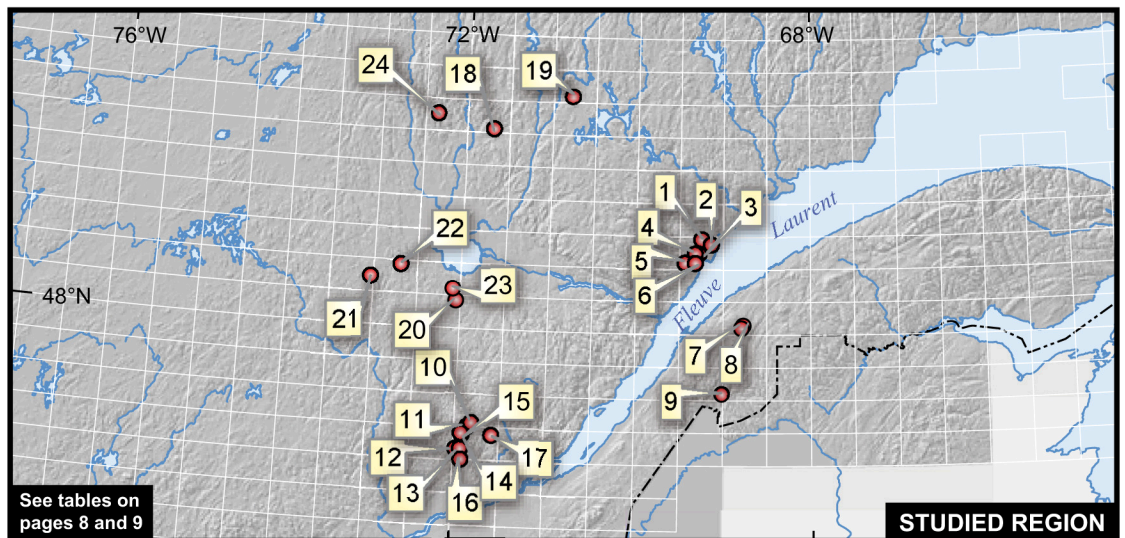
**PHOTO 12** - In the Saguenay – Lac-Saint-Jean region, calc-silicate rocks may be suitable to produce flagstone.

# LOCATION OF EXPLORATION TARGETS FOR ARCHITECTURAL STONE



## ADMINISTRATIVES REGIONS

- 1- Bas-Saint-Laurent
- 2- Saguenay – Lac-Saint-Jean
- 3- Capitale-Nationale
- 4- Mauricie
- 5- Estrie
- 6- Montréal
- 7- Outaouais
- 8- Abitibi-Témiscamingue
- 9- Côte-Nord
- 10- Nord-du-Québec
- 11- Gaspésie – Îles-de-la-Madeleine
- 12- Chaudière-Appalaches
- 13- Laval
- 14- Lanaudière
- 15- Laurentides
- 16- Montérégie
- 17- Centre-du-Québec



See tables on pages 8 and 9