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Report of Activities, 2015 Resident Geologist Program

Southern Ontario Regional Resident Geologist Report: Southeastern Ontario and Southwestern Ontario Districts and Petroleum Operations

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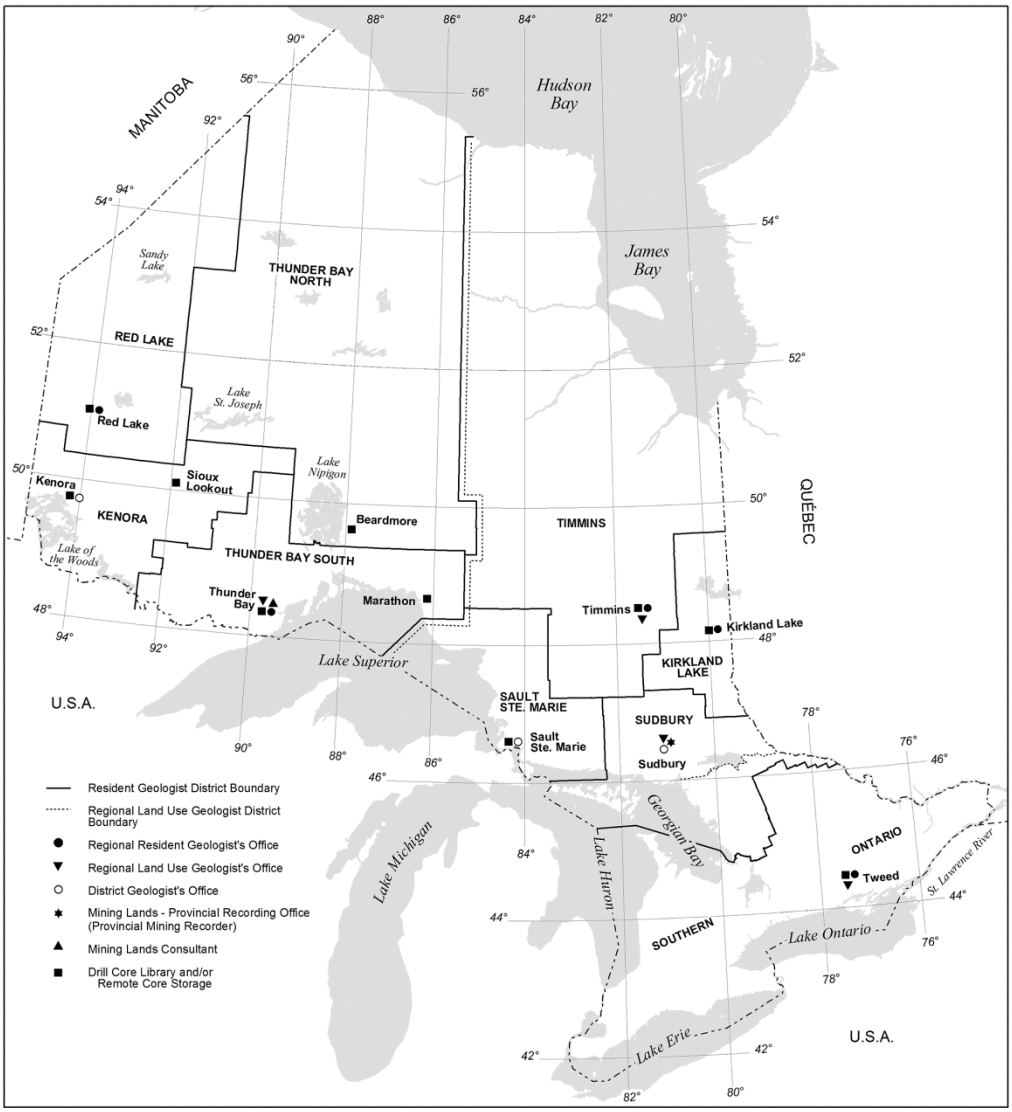

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ONTARIO GEOLOGICAL SURVEY

RESIDENT GEOLOGIST PROGRAM

REPORT OF ACTIVITIES—2015

SOUTHERN ONTARIO
REGIONAL RESIDENT GEOLOGIST REPORT

CONTENTS

Ontario

Ontario Geological Survey
Regional Resident Geologist Program

Southern Ontario Regional Resident Geologist
(Southeastern Ontario and Southwestern Ontario Districts)—2015

by

**P.J. Sangster, P.S. LeBaron, S.J. Charbonneau, D.A. Laidlaw,
R.L. Debicki and A.C. Wilson**

2016

CONTENTS

Southeastern Ontario and Southwestern Ontario Districts—2015

Tables

Figures

Photos

Southern Ontario Regional Resident Geologist (Southeastern Ontario and Southwestern Ontario Districts)—2015

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INTRODUCTION

The Southern Ontario Region encompasses the most populous part of the province and includes both the provincial and national capitals. The Region stretches over 700 km from the Canada–United States border in the west, through the southern Great Lakes (lakes Huron, Erie and Ontario) and along the St. Lawrence River to the Ontario–Quebec border in the east. The northern boundary of the Region cuts across Georgian Bay striking eastward north of Lake Simcoe, including Algonquin Park and neighbouring townships, ending at the Ottawa River and the Province of Quebec. From Paleozoic sedimentary rocks to the metamorphic terranes of the Central Metasedimentary Belt and Central Gneiss Belt, the Region hosts some of the most diverse and productive geology in the province.

Production from mines and quarries continued throughout southern Ontario within both the Grenville Province and in the Paleozoic rocks in the southwest and southeast. With the exception of salt mining and brine field operations in southwestern Ontario, all mining operations within the Paleozoic rocks are for commodities the development of which is designated under the *Aggregate Resources Act* administered by the Ministry of Natural Resources and Forestry.

In 2015, a total of 185 claims, comprising 787 16-hectare claim units, were recorded. This represents an increase of 90% in claim units recorded over the previous year. The majority of recording activity was centred on graphite and gold prospects. Claim staking in subdivided townships in the Southern Ontario Mining Division follows a map-staking system introduced in 2011. Claim staking activity is shown in Figure 3.

Tables 8 through 16 provide details on currently inactive mineral deposits with identified resources and past-producing mineral occurrences. Note: Unless otherwise stated, resource figures, given in these tables and elsewhere in this report, refer to historic resources only and are not compliant with National Instrument (NI) 43-101.

The authors note that all Web addresses referenced were accessed February 21, 2016, unless otherwise noted.

In addition, Universal Transverse Mercator (UTM) co-ordinates are provided in Zone 18 using North American Datum 1983 (NAD83), unless otherwise noted.

MINING ACTIVITY

During 2015, there were over 100 mineral extraction operations in southern Ontario, including 15 industrial mineral operations, 4 trap rock producers, 7 cement producer's quarries, 7 brick producer's quarries, 3 gemstone and mineral specimen sites and 64 dimension-stone quarries. All Ontario production of salt, gypsum/wallboard, natural gas and petroleum, shale/brick, lime/dolime, cement, nepheline, and the majority of dimension stone, sand and gravel comes from the Southern Ontario Region.

For a complete listing of mining activity and locations of operating mines and mills in southern Ontario, please refer to Tables 1 and 2, and Figures 1 and 2.

An estimated 5000 people were directly employed in mineral extraction and on-site processing plants in southern Ontario. In 2015, Ontario non-metallic mineral production was valued at $3.4 billion—representing 31% of the total value of mineral production in the province. Five of the top 10 commodities produced in 2015 were non-metallic minerals. Most of this production came from southern Ontario mines and quarries.

Wollastonite

CANADIAN WOLLASTONITE – ST. LAWRENCE DEPOSIT

Canadian Wollastonite (www.canadianwollastonite.com) is a privately held company incorporated in Ontario in 2001. The company owns just over 110 ha encompassing a large portion of the St. Lawrence wollastonite deposit north of Kingston near the community of Seeley's Bay. In December 2012, the Closure Plan was accepted by the Ministry of Northern Development and Mines and Canadian Wollastonite began to bring the deposit into production.

In 2013, the first year of production, the company crushed and shipped over 6500 t of wollastonite clear stone and sand products to metallurgical and agricultural markets. The company also won approval for use of its primary ancillary ore—orthogneiss—as a Superpave™ aggregate in highway road construction. The deposit is the southernmost approved source of Superpave™ aggregates in the Province of Ontario and is well situated to supply the eastern Ontario market.

In 2014, production increased to 44 000 t as the company introduced wollastonite (calcium silicate) and diopside (calcium magnesium silicate) products into the local Ontario horticultural market, as well as into the northeastern United States, as a single source of calcium, magnesium and silica. Wollastonite and diopside are both non-carbon dioxide–producing sources of these 3 elements, which are important elements in plant health and disease resistance. The company is also selling ore into the synthetic slag market. Plans for construction of an on-site beneficiation plant have been postponed until a joint venture partner with technical expertise and distribution channels has been found. (B. Vasily, Canadian Wollastonite, personal communication, January 2015).

Nepheline Syenite

In 2014, Unimin Canada Ltd. held a number of stakeholder meetings to announce a proposed modernization and consolidation of the company's nepheline syenite operations at Blue Mountain and Nephton in Methuen Township. In 2015, the process of permitting the expansion and modernization of the Blue Mountain operations and closure of the Nephton operations began. It is expected that permitting and engineering designs will take up to 2 years, followed by construction at Blue Mountain over the next 2 to 3 years (R. Marshall, Unimin Canada Ltd., personal communication, January 2016). The site has been in production for over 50 years and employs over 150 people.

Salt

Salt has been produced in Ontario since 1866. There are extensive beds of rock salt found in the Silurian Salina Group (formerly Formation) rocks in parts of southwestern Ontario, west of London.

Although there were numerous historic producers in southwestern Ontario, only a few produced more than 100 000 t of salt from brine well operations. Salt is the only Ontario mineral commodity for which the market and production are directly controlled by weather. Salt for de-icing is extracted from underground as warranted by the market demand.

Provincial and municipal governments are the main market for de-icing salt. The Ministry of Transportation reports that the Ministry's salt usage is highly dependent upon weather conditions, varying from 500 000 to 600 000 t of salt annually.

In 2014, Ontario produced 9.8 million tonnes of salt valued at an estimated $536 million, representing two thirds of the total salt production in Canada. Salt remains one of the top 10 minerals in the province by value of production.

Sifto Canada Corporation and the Canadian Salt Company each operate underground mines and brine fields in Goderich and Windsor, respectively. Rock salt from the underground mines is used mostly for road de-icing, for feedstock and in industry, where it is used in making a wide variety of products including chemicals, plastics and glass. Food-grade and chemical-grade salt are produced from the brine operations.

Sifto Canada (www.siftocanada.com) employs 490 people in the Goderich facilities. The Goderich Mine is the largest underground salt mine in the world. It has been operating for more than 50 years, producing 150 million tonnes of salt and has defined resources for an additional 120 years of production. The mine produces about 23 000 t of salt a day. About 80% is used as road salt, with the remainder trucked to the plant for refining into water softener or bagging as sidewalk salt. In 2014, the company began a 3-year, $150 million project to re-line shaft walls in the 600 m deep mine.

The Canadian Salt Company Limited, also known as Windsor Salt (www.windsorsalt.com), is a part of Morton International Inc. and is Canada's largest salt producer. It extracts both rock salt from the underground Ojibway Mine and vacuum salt from nearby brine wells in Windsor. Windsor Salt employs over 300 people at the Ojibway Mine and adjacent brine well field.

In December 2015, the company announced an initial $50 million investment in the underground operations and plans to increase production or refined salt from the brine plant by 30% (CBC News, December 9, 2015, www.cbc.ca/news/canada/windsor, "Windsor Salt plans expansions at 2 Windsor, Ont., mines" [accessed February 27, 2016]).

Brick and Shale

In 2015, there were 4 companies operating clay brick or tile plants in southwestern Ontario, all of which extract Queenston Formation shale as raw material. Total value of production in 2014 was $102 million.

Forterra Brick Ltd. (www.forterrabrick.com), formerly Hanson Brick Ltd., is a division of Forterra Building Products, based in Texas. The company purchased Hanson Brick Ltd. in 2015 and operates 3 brick plants in Burlington and 1 plant in Aldershot, with shale quarries located at Niagara-on-the-Lake, Burlington and Aldershot. Forterra is North America's largest brick manufacturer with a total capacity of more than 1.7 billion brick units per year. Of that total, 415 million units or approximately 25% are produced in Ontario. The company employs 130 people at its Ontario facilities.

Brampton Brick Ltd. (www.bramptonbrick.com) operates North America's single largest clay brick plant in Brampton, with production capacity of 300 million units per year. About 500 000 t of Queenston Formation shale are extracted annually from the Cheltenham quarry for the plant, which employs 75 people. The company reported that revenues increased by 8% to $40 465 000 for the quarter ended September 30, 2015, from $37 451 000 for the same period in 2014 as a result of higher shipments in the company's Canadian markets in both the Masonry Products and Landscape Products business segments (Brampton Brick Ltd., news release, November 3, 2015).

Paisley Brick and Tile Co. Ltd. quarries shale from the Hungry Hollow quarry (owned by Brampton Brick) in Williams Township for its plant in the village of Paisley. The operation employs 14 people.

Jazbrick, a Canadian company with its head office in Rexdale, operates the Century Brick Ltd. plant in Hamilton and the Rexdale Brick plant in Rexdale. Shale for the brick operations is quarried by Limehouse Clay Products Ltd. at the Halton Hills quarry near Georgetown.

Cement

There are 6 quarries and 6 modern processing plants in southern Ontario between Kingston in the southeast and St. Marys in the southwest. Production figures for 2014 show cement production in Ontario was valued at $632 million ("Ontario Mineral Production 2015", from MNDM Mineral Sector Analysis and Promotion staff, written communication, February 2016).

With the exception of Federal White Cement, each company has port facilities for Great Lakes shipping. The Bath, Picton, Bowmanville and Mississauga plants export significant production to the United States. Combined, the companies have 11 cement kilns with a total clinker production capacity of over 7.5 million tonnes per year.

St. Marys Cement (Canada) Inc., a subsidiary of Votorantim Cimentos, operates limestone quarry and cement plant complexes at Bowmanville and St. Marys. St. Marys Cement employs a total of 245 people at its Ontario facilities. In 2015, the company continued development of a proposal that would evaluate the potential of the underground mining of high-quality aggregate from beneath the Bowmanville quarry and the bed of Lake Ontario.

Lafarge Canada Inc., a subsidiary of Lafarge North America, operates a limestone quarry and cement plant at Bath near Kingston. In 2015, the company completed the first phase of a study on the potential to reduce carbon emissions by substituting low carbon fuels, such as asphalt shingles and wood from demolition debris, for coal. The tests indicated a reduction in carbon emissions by 70%, with no increases in other emissions (Lafarge Canada Inc. 2015, p.4-5).

CRH Canada Group Inc., formerly Holcim (Canada) Inc., operates a cement plant and adjacent shale quarry in Mississauga. Limestone is shipped to this cement plant from the company's Ogden Point quarry located on Lake Ontario at Colborne. The total number of employees at these operations is about 200.

ESSROC Canada Inc., a subsidiary of Italcementi Group, operates a quarry and cement plant at Picton with production capacity of about 1.2 million tonnes of clinker. The company employs 136 people at the Picton site.

Federal White Cement Ltd. operates a specialized white architectural cement plant near Woodstock using limestone purchased from local quarries. The plant employs about 50 people.

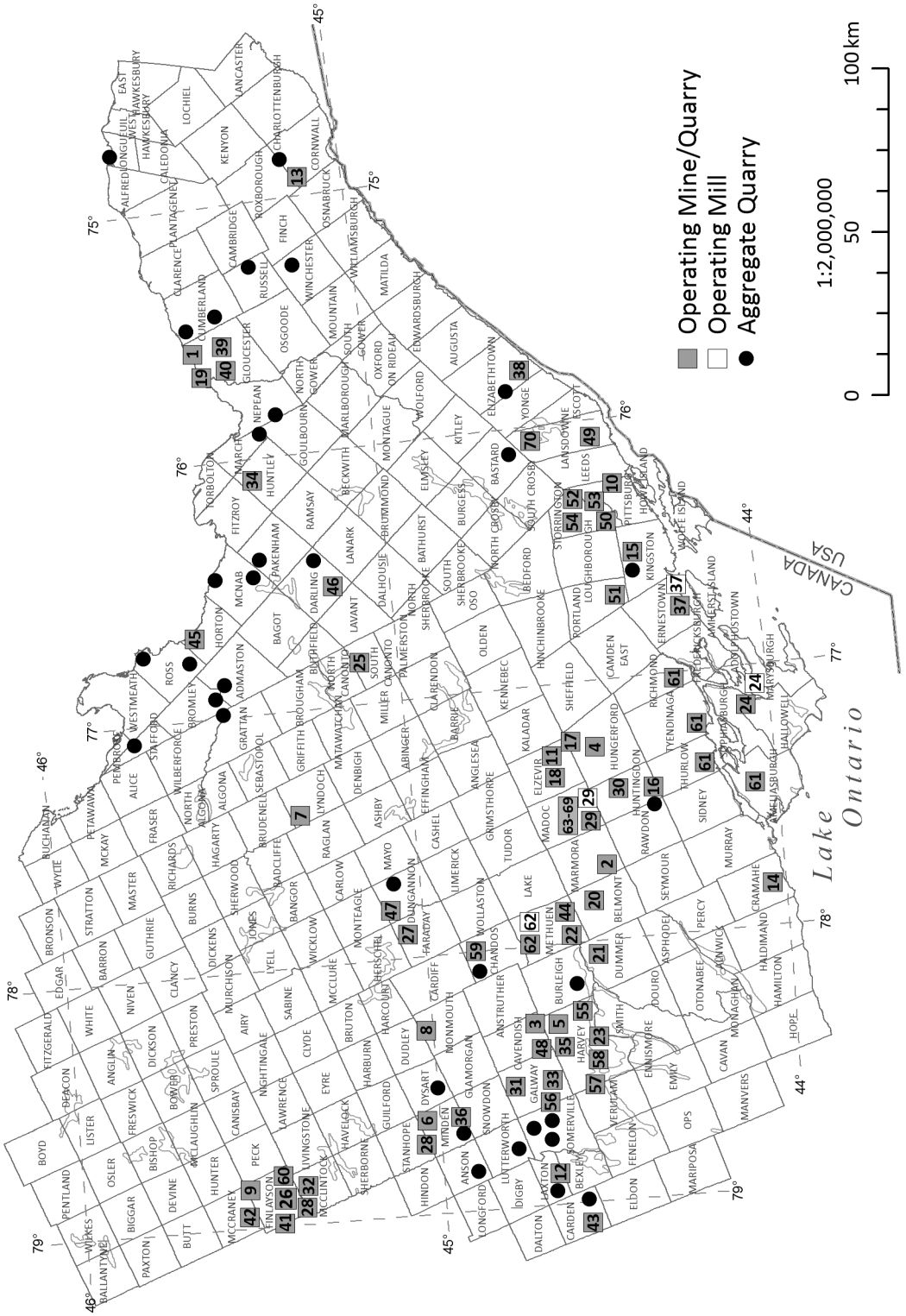

Figure 1. Mining activity in the Southeastern Ontario District in 2015 (keyed to Table 1).

Table 1. Mining activity in the Southeastern Ontario District in 2015 (keyed to Figure 1).

No.	Company/Individual (Mine Name)	Township(s) (Commodity)	Mining Activity
1	Aecon Construction and Materials Ltd.	Gloucester (Dolomitic sandstone)	Dolomitic sandstone from the Ottawa Quarry is produced from the lower member of the March Formation (11 m thick) for use in pavement aggregate.
2	Aecon Construction and Materials Ltd.	Marmora (Limestone)	Limestone aggregate is produced from site of former Marmoraton iron mine.
3	Aecon Construction and Materials Ltd. (Mountain Lake Quarry)	Cavendish (Granite, limestone)	Burgundy coloured granite and limestone are quarried for use as crushed stone aggregate and decorative stone.
4	A. Marmoro and Terrazzo Olympic, LLC (Tweed Marble Quarry)	Hungerford (Marble)	Quarry was purchased in 2013.
5	Amsen Quarries Ltd.	Harvey (Limestone)	Limestone landscaping stone products.
6	Attia Quarries	Minden (Granite)	Stone is quarried for use as landscaping, dimension, flag and masonry stone.
7	Aqua Rose Gems and Minerals (Beryl Pit / Rose Quartz Pit)	Lyndoch (Gemstones, mineral specimens)	Quarrying operations for rose quartz, beryl, feldspar, lyndochite, amazonite, cleavelandite, peristerite, columbite, fluorite and bertrandite. Two quarries are in operation: the Beryl Pit, which charges a fee for mineral collecting, and the Rose Quartz Quarry, which produces landscape stone.
8	Bancroft Chamber of Commerce (Bear Lake Diggings)	Monmouth (Mineral specimens)	Fee for collecting site near Wilberforce. Field trips to this site organized by the Bancroft Chamber of Commerce attract on average 40 to 50 participants. In 2008, a total of 606 people attended the field trips, with an estimated 10 000 attending the Bancroft Gemboree.
9	Boothby Quarry	Finlayson (Granite)	Granite gneiss is quarried for flagstone and landscape stone.
10	Canadian Wollastonite (St. Lawrence Mine)	Pittsburgh, Leeds and Lansdowne (Wollastonite)	Wollastonite skarn rock is produced and marketed as an agricultural soil additive. Gabbro is also being quarried and used in Superpave™ aggregate.
11	Carbroc Quarry (Z. Suder)	Elzevir (Marble)	The quarry began production in 2001. White calcitic marble is quarried seasonally and crushed on site. Crushed material has been used as dolomitic mineral filler with lower grade used as decorative aggregate.
12	Central Ontario Natural Stone (Batty Quarry)	Laxton (Limestone)	Grey, buff and black limestone is produced as flagstone.
13	Cornwall Gravel Company Ltd. (Cornwall Quarry)	Cornwall (Limestone)	Limestone for aggregate is quarried from this quarry north of Cornwall.
14	CRH Canada Group Inc. (Ogden Point Quarry)	Cramahe (Limestone, cement)	The quarry has been in production since 1959. It produces between 1.9 and 2.1 Mt of limestone per year. Crushed stone from the quarry is shipped by lake to the company's cement plant in Mississauga. The quarry employs 20 people.
15	Cruickshank Construction Limited	Kingston (Limestone)	The Elginburg Quarry near Kingston produces 500 000 t of limestone annually. This company has 12 operating quarries throughout eastern Ontario including Green Valley, Kemptville, Brockville, Iroquois, Napanee and Verona. They produce a range of products from fine aggregate to armour stone. Their stone has been used in shoreline protection projects along the St. Lawrence Seaway, including a $3.5 million breakwater and a marina project in Prescott.
16	Danford Construction Ltd. (Springbrook Road Quarry)	Huntingdon (Limestone)	Limestone is quarried and crushed for road aggregate and specialty concrete (seasonal operation). Annually, they produce 150 000 t of limestone and employ a staff of 24.
17	Danford Construction Ltd. (Tweed Quarry)	Elzevir, Hungerford (Granite-gneiss)	Granite-gneiss is extracted, crushed and approved for use in Superpave™ aggregates.
18	Danford Granite Ltd. (Bridgewater Trap Rock Mine)	Elzevir (Trap Rock)	Metabasalt is quarried for use as railway ballast. In 2015, a 30 000 tonne blast was completed and the company began shipping 2200 tonne batches of crushed basalt/gabbro to Roxul Inc. in Milton for testing in rock wool production. Testing to date has given favourable results and the company is planning a second 30 000 tonne blast.
19	Dibblee Paving & Materials Ltd.	Gloucester (Dolomitic sandstone)	Dolomitic sandstone from the Boyce Quarry is removed from the lower member of the March Formation.
20	Drain Bros. Excavating Inc. (Havelock Quarry)	Belmont (Basalt)	Basalt is extracted for use as trap rock.

No.	Company/Individual (Mine Name)	Township(s) (Commodity)	Mining Activity
21	Drain Bros. Excavating Inc.	Dummer (Limestone)	Limestone for use as road aggregate.
22	Drain Bros. Excavating Inc.	Methuen (Granite)	Crushed stone for aggregate.
23	Dufferin Aggregates	Harvey (Limestone)	Grey limestone is extracted for use as armour stone, landscaping stone and crushed stone.
24	Essroc Canada Inc. (Picton Quarry)	Sophiasburg (Cement)	A cement plant and on-site limestone quarry with an annual production of slightly less than 1 000 000 tons. This is one of the largest cement plants in North America and employs 160 people.
25	Ferromin Inc. (Tomclid Iron Mine)	South Canonto (Magnetite)	Magnetite is mined and crushed as high-density aggregate for use in heavy concrete applications including radiation shielding.
26	Fraser Quarry	Finlayson (Gneiss)	Predominantly pink gneiss is extracted for landscaping and other decorative applications.
27	Graf Quarry	Faraday (Marble)	A variety of landscape and dimension stone is extracted from a quarry of calcitic marble breccia formerly held by Senator Stone and marketed as “Temagami Pink”.
28	Haliburton Stone Works	McClintock, Minden (Granite, dolomite and limestone)	A variety of granite and limestone dimensional and landscape stones produced from 2 quarries.
29	I.K.O. Industries Ltd. (I.K.O. Quarry)	Madoc (Trap Rock)	Since 1991, I.K.O. Industries Ltd. has operated a trap rock quarry east of Madoc on the south side of Hwy 7. The quarry is located within a ridge of grey to black, fine-grained, agglomeratic metavolcanic rock. An on-site mill and colouring plant produce roofing granules, which are trucked to the company’s asphalt shingle manufacturing plant in Brampton. In addition to roofing granules, stone from the quarry is crushed to produce HL-1 aggregate (asphalt road surfacing mix). The quarry is licenced under the *Aggregate Resources Act* to produce up to 1 Mt per year.
30	JC Rock (Crookston Quarry)	Huntingdon Tp. (Limestone)	Historic producer; in 2010, saw dimension stone removed for restoration project, Belleville.
31	Jeff Parnell Contracting Limited	Galway (Limestone)	Natural and dimension-cut armour stone, rockery stone, garden stone, natural surface steps and natural and dimensional flagstone.
32	John Bacher Construction Limited	McClintock (Granite, gneiss)	Building stone, flagging stone, and landscaping stone.
33	Johnston Quarry	Galway (Limestone)	Gull River Formation limestone is removed for use as landscaping stone, flagstone and building stone.
34	Karson Kartage & Konstruction Ltd. (Clarke Quarry)	Huntley (Limestone)	The quarry produces limestone for use as road aggregate.
35	Kawartha Rock Quarry Inc.	Harvey (Limestone)	Limestone is quarried to produce armour stone and flagstone.
36	Keystone Granite	Minden (Granite)	Granite is quarried for use as armour, flags, steps and dimension stone.
37	Lafarge Canada Inc. (Bath Quarry)	Ernestown (Cement)	A cement plant and on-site limestone quarry with a capacity to produce 1 Mt of cement. Silica used in the production of cement is extracted from the company’s Potsdam sandstone quarry in Pittsburgh Tp. as well as from recycled foundry sands.
38	Lafarge Canada Inc. (Brockville Quarry)	Elizabethtown (Dolomitic sandstone)	Dolomitic sandstone from the lower member of the March Formation (at least 19 m thick) is used for road aggregate. Markets are served in the Brockville, Prescott and Cardinal areas.
39	Lafarge Canada Inc. (Bearbrook Quarry)	Gloucester (Limestone)	Limestone of lower member Gull River Formation and upper member Bobcaygeon Formation is quarried for use as high-quality aggregate.
40	Lafarge Construction (Hawthorne Quarry)	Gloucester (Dolomitic sandstone)	Material from the lower member of the March Formation (11 m thick) is crushed for use as road aggregate.
41	McDonald Quarry	Finlayson (Gneiss)	Flagstone, building stone, armour stone
42	McFayden Quarry	Finlayson (Gneiss)	Flagstone, building stone, armour stone, guillotine cut ashlar, sawn thinstone veneer and custom guillotine, hearths and pier caps.
43	Miller Paving Ltd.	Carden (Limestone)	This quarry east of Brechin produces grey limestone for use as aggregate, architectural stone, landscaping/armour stone, asphalt limestone, crushed limestone and manufactured sand.

No.	Company/Individual (Mine Name)	Township(s) (Commodity)	Mining Activity
44	MRT Aggregates Inc. (MRT Traprock)	Methuen (Trap Rock)	Metagabbro is quarried and crushed on site for use as premium aggregate for HL-1 purposes. Portable crusher is moved on site as required. Production began in December 2002 and, in 2003, production totalled 100 000 t. The product is used by Miller Paving and also sold outside the company.
45	Nesbitt Aggregates	Horton (Granite)	Granite riverstone is quarried, sorted and split for use as flagstone, fieldstone, landscaping and masonry stone. The majority of production is exported to the United States.
46	OMYA (Canada) Inc. (Tatlock Quarry)	Darling (Calcite)	Calcitic marble is mined to produce high-purity, fine-grind calcite for fillers with terrazzo chips and landscaping stone as secondary products. Annual production is 250 000 tons and quarry reserves currently stand at over 5 000 000 tons.
47	Princess Sodalite Mine	Dungannon (Sodalite)	Decorative stone, landscaping stone, mineral specimens including fee for collecting.
48	Redstone Quarries	Galway, Harvey, Cavendish (Limestone, sandstone)	Beige limestone and red sandstone are quarried for weathered landscaping stone and armour stone blocks.
49	Rideauview Contracts Ltd. (Ellisville Quarry)	Rear Leeds & Lansdowne (Sandstone)	Sandstone produced for flagstone, granite blocks and masonry stone.
50	Rideauview Contracts Ltd. (McCallum Quarry)	Storrington (Limestone)	Limestone is quarried for building restoration in Kingston and for new construction.
51	Rideauview Contracts Ltd. (Petworth)	Portland (Limestone)	Limestone is quarried for building restoration in Kingston and for new construction.
52	Rideauview Contracts Ltd. (Rideauview Quarry)	Storrington (Sandstone)	Red sandstone is produced for ashlar and flagstone.
53	Rideauview Contracts Ltd. (Sloan Quarry)	Storrington (Sandstone)	Cream and red sandstone are quarried for the production of ashlar, flagstone and landscaping stone at the Sloan Quarry.
54	Rideauview Contracts Ltd. (Battersea Quarry)	Storrington (Granite)	Red granite is quarried at the Battersea Quarry.
55	Rigbe's Quarry	Harvey (Limestone)	Buff limestone is removed for use as weathered armoury and rockery, crushed aggregates and landscape stone.
56	Royel Paving	Galway (Granite)	Granite is quarried and crushed on site for road aggregate.
57	Stone Cottage Inn Ltd. (Attia Quarries)	Harvey (Limestone)	Grey limestone is quarried for dimension stone.
58	Stonescape Quarry	Harvey (Limestone)	Limestone flagstone and ledgerock are quarried north of Buckhorn.
59	T. Pluard (Elite Blue)	Chandos (Marble)	A blue grey metasedimentary rock is extracted for a variety of uses including armour stone, landscaping stone and dimension stone
60	Tasso Lake Quarry	Finlayson (Gneiss)	Flagstone, dimension stone, landscaping stone
61	The Warren Paving and Materials Group	Ameliasburgh, Hillier, Tyendinaga, Thurlow, Richmond (Limestone)	Rough dimension stone blocks, armour stone, flagstone and crushed limestone are produced. Most of the quarries are operated on an as-needed basis.
62	Unimin Canada Ltd. (Blue Mountain Quarry)	Methuen (Nepheline syenite)	Nepheline syenite is mined from a quarry and processed in 2 mills at Nephton and Blue Mountain, respectively. Magnetite is produced as a by-product. Production rate is 2500 tons per day. The mine opened in 1955 and employs 152 people.
63	Upper Canada Stone Co. Ltd. (Pink Marble Quarry)	Madoc (Marble)	Pink marble is quarried for landscaping stone, boulders and terrazzo.
64	Upper Canada Stone Co. Ltd. (Royal Green Marble Quarry)	Huntingdon (Marble)	Light green, fine-grained marble is quarried for use as landscaping stone, dimension stone and terrazzo.
65	Upper Canada Stone Co. Ltd. (Madoc White Marble Quarry)	Marmora (Marble)	This quarry has been in production since the 1950s. White marble is quarried primarily for use as terrazzo as well as custom clear stone and sand. "Madoc White" marble is the white terrazzo staple in Canada.
66	Upper Canada Stone Co. Ltd. (Medium Buff Marble Quarry)	Madoc (Marble)	Fine-grained marble is quarried for use as landscaping stone, decorative aggregate and accent boulders under the name "Caramel Cream".
67	Upper Canada Stone Co. Ltd. (Black Marble Quarry)	Madoc (Marble)	Fine grained, consistently black, marble is quarried for use as terrazzo, precast concrete panels, landscaping stone, decorative roofing, textured coatings, acrylic stuccos and speciality construction.

No.	Company/Individual (Mine Name)	Township(s) (Commodity)	Mining Activity
68	Upper Canada Stone Co. Ltd. (Blue-Grey Marble Quarry)	Madoc (Marble)	Very fine-grained marble is quarried for use as terrazzo, custom clear stone and sand.
69	Upper Canada Stone Co. Ltd. (Light-Buff Marble Quarry)	Madoc (Marble)	Fine-grained marble is quarried for use as landscaping stone and terrazzo.
70	Upper Canada Stone Co. Ltd. (Kingston Red Granite Quarry)	Rear of Leeds and Lansdowne (Granite)	Red granite is produced for precast concrete panels, pavers, split block, spun concrete poles and landscaping.

Table 2. Producing mines and quarries in the Southwestern Ontario District* in 2015 (keyed to Figure 2).

No.	Company/Individual (Mine or Quarry Name)	Township(s) (Commodity)	Mining Activity
1	A & A Natural Stone Ltd. (A & A Quarry)	Keppel (Dolostone)	Grey dolostone is produced for use as flagstone, landscape stone and specialty aggregate.
2	Amsen Quarries Ltd. (Mar Quarry)	Albemarle (Dolostone)	Light and dark brown dolostone is produced for use as flagstone and building stone.
3	Amsen Quarries Ltd. (Wiarton Quarry)	Amabel (Dolostone)	Light and dark brown dolostone is produced for use as flagstone and building stone.
4	Arriscraft International Inc. (Adair Marble Quarries)	Albemarle (Dolostone)	Dolostone is produced for use as architectural stone.
5	Attia Quarries (Rama Quarry)	Rama (Dolostone)	Stone is quarried for use as landscaping, dimension, flag and masonry stone.
6	Attia Quarries (Seabright Quarry)	Rama (Dolostone)	Stone is quarried for use as landscaping, dimension, flag and masonry stone.
7	Block and Stone Resource Group Inc.	Amabel (Dolostone)	Dolostone is quarried for use as dimension stone.
8	Brampton Brick Ltd. (Cheltenham Quarry)	Chinguacousy (Shale)	Queenston Formation shale is extracted for use in the company's brick plant.
9	Brampton Brick Ltd. (Hungry Hollow North Quarry)	Williams (Shale)	Shale is extracted for use in the company's brick plant.
10	Bruce Peninsula Stone Ltd. (Lindsay Quarry)	Lindsay (Dolostone)	Dolostone is produced for landscaping and building stone products.
11	Bruce Peninsula Stone Ltd. (Wiarton Quarry)	Amabel (Dolostone)	Dolostone is produced for landscaping and building stone products.
12	Bruce Peninsula Stone Ltd. (Mar Quarry)	Albemarle (Dolostone)	Dolostone is quarried for use as dimension stone.
13	Carmeuse Lime Canada Ltd. (Beachville Quarry)	Zorra (Limestone)	Limestone is extracted, crushed and processed in on-site lime plant.
14	CGC Inc. (Hagersville Mine)	Oneida (Gypsum)	An on-site wallboard plant utilizes gypsum from the mine.
15 A	Compass Minerals (Goderich Mine and brine fields)	Goderich (Salt, salt in brine)	This is the largest underground salt mine in the world. The company also produces salt from an adjacent brine field (A) operation. Most production is distributed via Great Lakes shipping. 2015 is in the first year of a 3-year, $150 million project to re-line shaft walls in the 600 m deep mine.
16	Credit Valley Quarries Co. Ltd.	Caledon, Chinguacousy (Sandstone, limestone)	Sandstone is extracted for construction and landscaping applications. The stone has been used in many notable buildings including Toronto's Old City Hall and the Ontario Legislature (Queen's Park).
17	CRH Canada Group Inc. (Mississauga Quarry)	Toronto (Shale)	CRH Canada Group Inc. operates a cement plant and adjacent shale quarry. Limestone is shipped to the plant from Ogden Point quarry on Lake Ontario at Colborne. Formerly Holcim Canada Inc.
18	Cut Above Natural Stone (Cut Above Natural Stone Quarry)	Rama (Limestone)	Buff brown, white, light to dark grey limestone is quarried for use as armour stone, cubical weathered wallstone, flagstone and random slabs.
19	Deforest Brothers Quarry Ltd. (Deforest Brothers Quarry)	Caledon (Sandstone)	Red, grey, buff, piebald-textured sandstone is produced for use as steps, coping, wallstone, ledgerock and landscaping stone.
20	Dufferin Aggregates (Flamborough Quarry)	West Flamborough (Dolostone)	Dolostone is produced for use as armour, landscaping and crushed stone.

No.	Company/Individual (Mine or Quarry Name)	Township(s) (Commodity)	Mining Activity
21	E.C. King Contracting Ltd. (Sydenham Quarry)	Sydenham (Dolostone)	High-purity dolostone is crushed for aggregate.
22	Ebel Quarries Inc. (Ebel and Arnold Property quarries)	Amabel (Dolostone)	Light and dark brown and black dolostone is produced for use as flagstone, landscaping stone, slabs, steps and wallstone.
23	Forterra Brick Ltd. (Aldershot Quarry)	East Flamborough (Shale)	Queenston Formation shale is extracted for use in the company's brick plant. Formerly Hanson Brick Ltd.
24	Forterra Brick Ltd. (Burlington Quarry)	East Flamborough (Shale)	Queenston Formation shale is extracted for use in the company's brick plant. Formerly Hanson Brick Ltd.
25	Forterra Brick Ltd. (Niagara-on-the-Lake Quarry)	Niagara (Shale)	Queenston Formation shale is extracted for use in the company's brick plant. Formerly Hanson Brick Ltd.
26	Fowler Construction Company Limited (Fleming Quarry)	Rama (Gneiss)	Granitic gneiss is quarried for use as flagstone, building, landscaping, masonry and crushed stone.
27	Georgian Bay Marble and Stone (Cook Quarry)	Amabel (Dolostone)	Dolostone is produced for use as landscaping stone, steps and building stone.
28	Gott Natural Stone (Hewitt Quarry)	Orillia (Limestone)	Limestone is quarried for use as aggregate, thin veneer and dimension stone from several quarries in the area.
29	Harold Sutherland Construction (Lindsay, Keppel, Sarawak and Meaford Quarries)	Lindsay, Keppel, Sarawak (Dolostone)	Dolostone is extracted and crushed for use as aggregate.
30	Hilltop Stone and Supply Inc. (Hilltop Quarry)	Esquesing (Sandstone)	Grey and buff sandstone is quarried for use as flagstone, masonry stone and dimension stone.
31	James Lamb	Rama (Dolostone)	Crushed stone aggregate is produced.
32	Jazbrick (Georgetown Quarry)	Esquesing (Shale)	Queenston Formation shale is extracted for use in the company's brick plant. Formerly Century Brick Ltd.
33	Lafarge Canada Inc. (Dundas Quarry)	West Flamborough (Dolostone)	Dolostone is crushed for use as high-quality aggregate.
34	Lafarge Canada Inc. (Woodstock Quarry)	Zorra (Limestone)	Limestone is extracted and crushed for aggregate from quarry near site of former cement plant.
35	Limberlost Stone Inc. (Limberlost Quarry)	Albemarle (Dolostone)	Light and dark brown and grey dolostone is quarried for use as flagstone, landscaping stone, steps, slabs, coping and coursing.
36	Owen Sound Ledgerock Ltd. (Hope Bay Quarry)	Albemarle (Dolostone)	Dolostone is produced for use as custom cut and architectural cut stone, masonry, ledgerock wallstone, marble tiles and slabs and landscape stone.
37	Owen Sound Ledgerock Ltd. (Owen Sound Quarry)	Keppel (Dolostone)	Dolostone is produced for use as custom cut and architectural cut stone, masonry, ledgerock wallstone, marble tiles and slabs and landscape stone.
38	Owen Sound Ledgerock Ltd. (Senesun and Wiarton quarries)	Amabel (Dolostone)	Dolostone is produced for use as custom cut and architectural cut stone, masonry, ledgerock wallstone, marble tiles and slabs and landscape stone.
39	Rice and McHarg Ltd. (Rice and McHarg Quarry)	Esquesing (Sandstone)	Grey and buff sandstone is produced for use as flagstone, masonry and landscaping stone.
40	Rockleith Quarry Ltd. (Rockleith Quarry)	Orillia (Limestone)	Beige, tan and blue-gold limestone and dolomitic limestone is produced for use as dimensional building stone.
41	Speiran Quarries Ltd. (Speiran Quarry)	Rama (Limestone)	The quarry is operated by Gott Natural Stone '99 Inc. White limestone is produced for use as flagstone, landscaping stone, waterfall slabs, retaining wall blocks and steps.
42	St. Marys Cement Inc. (Bowmanville Quarry)	Darlington (Limestone)	Limestone quarry and cement plant at Bowmanville.
43	St. Marys Cement Inc. (St. Marys Quarry)	Blanshard (Limestone)	Limestone quarry and cement plant complex at St. Marys.
44 B	The Canadian Salt Company Ltd. (Ojibway Mine and brinefields)	Sandwich (Salt, salt in brine)	Underground workings are adjacent to international border. The company also produces salt from an adjacent brine field (B) operation. In 2015, the company began a multi-year, $300 million investment in the mine and brine fields, expected to add 45 years of mine life beyond the current 10 year projection.
45	Wiarton Buckskin Quarry Co. Ltd.	Amabel (Dolostone)	Dolostone is extracted and processed for use as flagstone, steps, slabs and curbing stone.

No.	Company/Individual (Mine or Quarry Name)	Township(s) (Commodity)	Mining Activity
46	Wiarton Stone Quarry Inc. (Wiarton Stone Quarry)	Amabel (Dolostone)	Light brown, grey/beige and black dolostone is quarried for use as flagstone, steps, waterfall stone, curbing stone.

**All oil and gas production in Ontario occurs in the Southwestern Ontario District. For information on oil and gas exploration and development activity in Ontario in 2015, please refer to the report of the Petroleum Operations Section (this volume).*

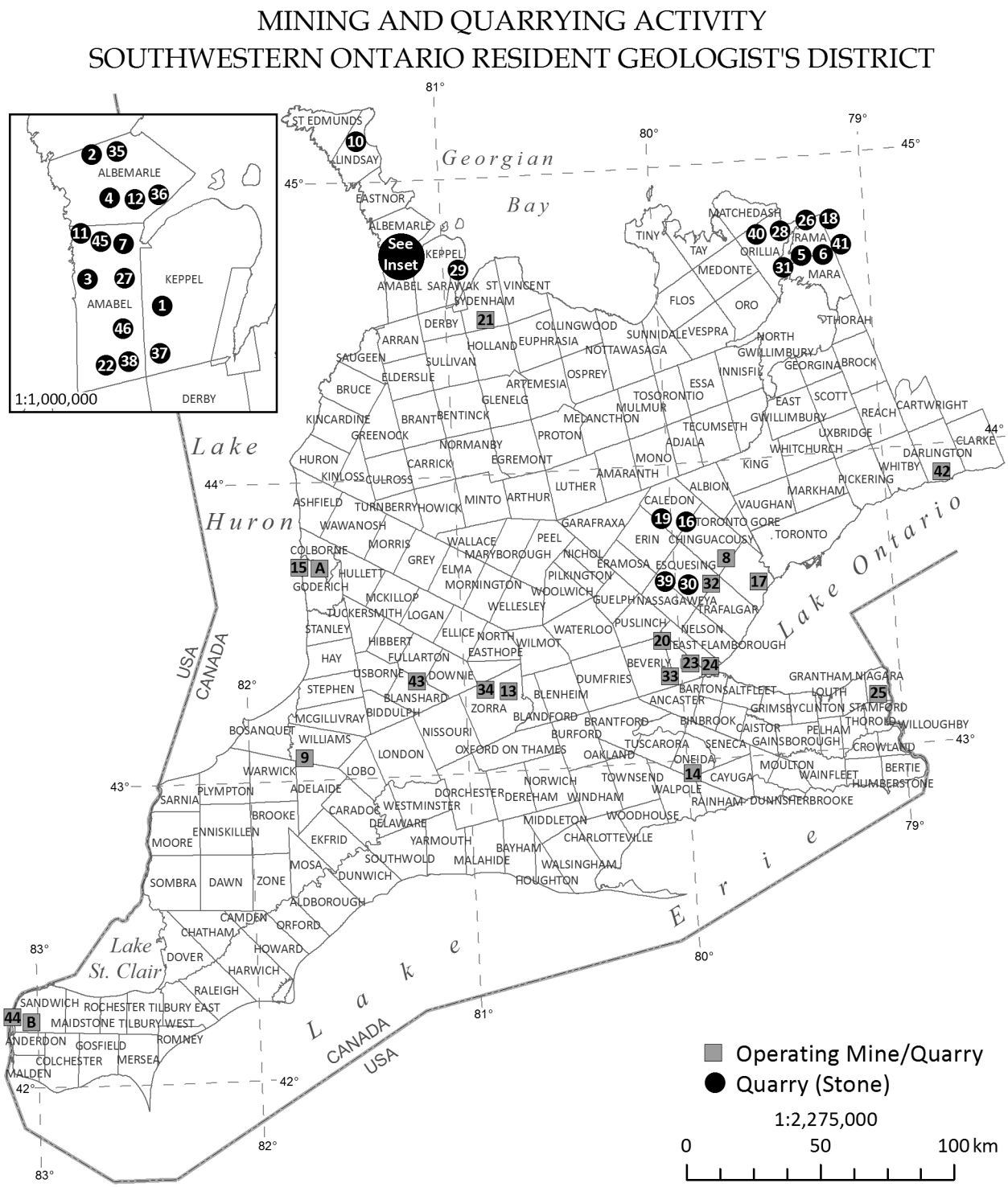

Figure 2. Producing mines and quarries in the Southwestern Ontario District in 2015 (keyed to Table 2).

Dimension and Building Stone

WIARTON AREA QUARRIES

The Wiarton area on the Bruce Peninsula in southwestern Ontario is the centre of the province's dimension-stone industry. As of 2015, 22 quarries were licenced under the *Aggregate Resources Act* to extract dimension stone for building, landscaping and flagstone markets in the County of Bruce. An additional 15 quarries are licenced to extract stone in the neighbouring County of Grey. Rowell (2012) identifies, as provincially significant, bedrock resources in the County of Bruce and also provides details of national and provincial parks, physical, cultural and environmental constraints on development, including the Niagara Escarpment Plan, which limit development of resources within that area for dimension stone as well as crushed stone aggregate.

In 2014, scientists from the Royal Ontario Museum identified a new, mid-Silurian species of aquatic fossil scorpions, *Eramoscorpius brucensis,* the oldest known scorpions from North America and among the oldest in the world (Waddington, Rudkin and Dunlop 2015). Specimens were initially noted by quarry workers, amateur collectors and were also noted in quarried stone delivered to landscaping work sites.

SANDSTONE QUARRIES

The first of many sandstone quarries near the Forks of the Credit River was opened in 1840. Edward Townsend and his sons operated the largest quarry in the area, which was sold to Torontonian Jack Murray in 1898 for $300 000, then later to Francis and William Rogers in 1909. William Norrie, who purchased the quarry in 1930, was the final owner, naming his operations Credit Valley Quarries. Previously, product from the area was known as Credit Valley stone.

Credit Valley stone was used in the construction of a number of notable projects in Toronto including Old City Hall, the Ontario Legislature (Queen's Park), pillars at Union Station, and the Timothy Eaton Memorial Church.

There is a perennial demand for Credit Valley sandstone for new projects as well as an overwhelming demand for restoration of many historic sandstone buildings in the Greater Toronto Area.

In southeastern Ontario near Kingston, Nepean Formation (Cambrian age) sandstone is quarried and processed as dimension stone in a variety of finishes for stone veneer, lintels, headers, steps, stone blocks and archways. The stone is used for restoration projects in Canada and the United States, as well as for new building projects. Nepean Formation sandstone is also a popular landscaping stone.

ORILLIA AREA QUARRIES

Five companies operate a total of 7 dimension-stone quarries in Rama Township near Orillia in Paleozoic limestone of the Gull River Formation. Each of the companies has some form of on-site processing to split and/or cut stone to customer specifications. Both white-weathering, micritic limestone and, to a lesser extent, beige-weathering dolostone from the Gull River Formation are extracted from the Orillia area quarries for use as landscape, masonry and armour stone. All of these quarries are situated on lands where both mining and surface rights are privately owned. The quarries at Longford, opened in the 1880s and now inactive, were well known for both limestone (Longford Stone) and dolostone (Rama Stone) used in the construction of many historic buildings in Toronto, Peterborough and Orillia.

PETERBOROUGH AREA QUARRIES

There has been a long history of dimension stone production in the Peterborough area. In 2015, 6 companies operated 6 dimension-stone quarries in the Peterborough area. Stone from these quarries is produced for export as well as for local markets.

In 4 of the quarries, Paleozoic limestone of the Gull River Formation is extracted for a variety of applications, including landscape, masonry and armour stone. Each of the companies has some form of on-site processing to split and/or cut stone to customer specifications. The Parnell quarry in Galway Township is located on a contact between the Paleozoic sedimentary rock and Proterozoic metamorphic rock of the Canadian Shield. In addition to Gull River Formation dolostone, deep red ("wine") granite has been quarried at this site. At the Plourde quarry in Chandos Township, a blue-grey interbedded marble and amphibolite unit is quarried to produce "Elite Blue" dimension stone. Four of these quarries are situated on lands where both mining and surface rights are privately owned. The remaining 2 quarries are located on Crown land.

KINGSTON AREA QUARRIES

Quarrying of limestone as building stone in the Kingston area began in the early 1800s and the industry expanded rapidly during construction of the Rideau Canal from 1826 to 1832. Kingston limestone, white-weathering, micritic limestone of the Gull River Formation, is a prominent feature of many government buildings, churches and the buildings of Queen's University and the Royal Military College.

Rideauview Contracts Ltd. operates the only 2 quarries that currently produce limestone dimension stone: the Petworth Quarry, about 25 km northwest of Kingston and the McCallum Quarry, about 10 km northeast of Kingston on the Battersea Road. In 2015, the company continued the process of acquiring a permit to expand the Petworth Quarry to the north, potentially doubling the surface area of the quarry (W. Jackson, Rideauview Contracts, personal communication, January 2016). Stone from the Petworth Quarry (Photo 1) has been used in recent years in restoration of buildings at the Royal Military College.

Photo 1. Thickly bedded, micritic limestone of the Gull River Formation, Petworth Quarry; hammer, for scale, is 35 cm long. Inset (at top right) shows Petworth stone in a building wall (McDonald's restaurant, Division St., Kingston), exhibiting the white patina typical of Kingston limestone, developed during the 30 years since installation.

Trap Rock

There are 4 companies operating trap rock quarries in southeastern Ontario, all located within the area of Highway 7 between Peterborough and Tweed. Products include roofing granules, high-performance aggregate, railway ballast, and raw material for mineral wool production.

Drain Bros. **Excavating Ltd.** quarries metabasalt near Havelock for the production of railway ballast, filter stone, high-performance aggregate, and mineral wool raw material. The company has on-site crushing facilities.

MRT Aggregates Inc. operates a quarry in metagabbro about 20 km north of Havelock. The company produces crushed stone on site for use as high-performance aggregate and railway ballast.

IKO Industries Ltd. quarries a fine-grained, massive, intermediate rock, classified as andesite, for the production of roofing granules. The company has an on-site crushing and colourizing plant. The granules are shipped to the company's Brampton plant for manufacturing asphalt shingles.

Danford Granite Ltd. operates the Bridgewater trap rock quarry about 4 km north of Highway 7, between Madoc and Tweed. The company has opened quarries in both high-iron gabbro and high-magnesium gabbro. The former has been tested and approved as railway ballast and road aggregate; the latter is under development as a source of raw material for mineral wool manufacturing. In 2015, the company conducted a re-sampling program on archived diamond-drill core, stored at the Tweed Drill Core Library, from a past talc exploration program on the property as part of an evaluation of the consistency of the high-magnesium zone. The company followed up the core sampling program with a 30 000 tonne blast, which provided material for rock wool manufacturing tests at Roxul Inc. in Milton. The results were positive and the company plans to increase production at the Bridgewater quarry in 2016 (A. Danford, Danford Granite Ltd., personal communication, January 2016).

Calcium Carbonate (Marble)

OMYA Canada Inc. extracts white, calcitic marble from a high-purity zone about 85 m wide at the company's Tatlock Quarry in Darling Township. The marble is shipped to the company's processing plant at Perth for production of ground calcium carbonate products that are used primarily in the paint, paper and plastics industries. In high-demand years, the company quarries about 250 000 tonnes from the deposit.

EXPLORATION ACTIVITY

Assessment files received for the Southeastern Ontario District are listed in Table 3. Exploration activity is listed in Table 4 and locations of exploration projects are shown in Figure 3. The lack of assessment work in southwestern Ontario is because the vast majority of exploration occurs on private land where there is no requirement for the submission of assessment work.

Table 3. Assessment files received in the Southeastern Ontario District in 2015.

Abbreviations

AEM ..... Airborne electromagnetic survey
AM ..... Airborne magnetic survey
ARA ..... Airborne radiometric survey
Beep ..... Beep Mat survey
Bulk ..... Bulk sampling
DD ..... Diamond drilling
DDH ..... Diamond-drill hole(s)
Enviro ..... Environmental base line survey
GC ..... Geochemical survey
GEM ..... Ground electromagnetic survey
GL ..... Geological survey
GM ..... Ground magnetic survey
GRA ..... Ground radiometric survey
Grav ..... Gravity survey
HLEM ..... Horizontal loop electromagnetic survey
HM ..... Heavy mineral sampling
IM ..... Industrial mineral testing and marketing
IP ..... Induced polarization survey
Lc ..... Line cutting
Met ..... Metallurgical testing
Micro ..... Microscope (mineral identification)
OD ..... Overburden drilling
ODH ..... Overburden drill hole(s)
OMIP ..... Ontario Mineral Incentive Program
OPAP ..... Ontario Prospectors Assistance Program
PEM ..... Pulse electromagnetic survey
PGM ..... Platinum group metals
Pr ..... Prospecting
RES ..... Resistivity survey
Samp ..... Sampling (other than bulk)
Seismic ..... Seismic survey
SP ..... Self-potential survey
Str ..... Stripping
Tr ..... Trenching
VLEM ..... Vertical loop electromagnetic survey
VLFEM ..... Very low frequency electromagnetic survey

No.	Township or Area (Commodity)	Company Name	Year	Type of Work	AFRO Number	Resident Geologist Office File Designation
1	Ashby (Kimberlite)	R. Lawrence	2015	Assay, Pr	2.56076	Ashby #24
2	Barrie (Au)	M. Glanfield	2013–2015	Assay	2.56216	Barrie #117
3	Cardiff (U, Th, REE)	Skead Holdings Ltd.	2013–2014	Pr	2.55829	Cardiff #266
4	Cardiff (U, Th, REE)	Skead Holdings Ltd.	2014–2015	Pr	2.55832	Cardiff #265
5	Cardiff (U, Th, REE)	Skead Holdings Ltd.	2014	Pr	2.55822	Cardiff #264
6	Cardiff (U, Th, REE)	Skead Holdings Ltd.	2014	Assay	2.55826	Cardiff #263
7	Cardiff (U, Th, REE)	Skead Holdings Ltd.	2013	Assay	2.55830	Cardiff #262
8	Cardiff (U, Th, REE)	Skead Holdings Ltd.	2014–2015	Assay, Pr	2.55831	Cardiff #261
9	Effingham (PGM, Au, Diamond)	R. Lawrence	2015	Micro, Pr	2.55808	Effingham #18
10	Effingham (PGM, Au, Diamond)	R. Lawrence	2014	Pr, Assay	2.55660	Effingham #17
11	Galway (Graphite)	J. Archibald	2015	Assay, GL, Str	2.56123	Galway #74
12	Hindon (Cu)	JD Exploration Inc.	2014–2015	Micro	2.55766	Hindon #27
13	Kaladar (Au)	D. Baird	2015	GC, Pr, GL	2.56019	Kaladar #75
14	Limerick (Base Metals, PGM)	D. McBride, J. McBride, J. Laidlaw, J. Ryder	2014–2015	GL, Pr	2.55886	Limerick #27
15	Lyndoch (Graphite)	M. Forget	2015	GC, GL, Str	2.56175	Lyndoch #56
16	Monmouth (Mineral Specimens)	The Corporation of the Municipality of Highlands East	2015	Pr	2.56018	Monmouth #183
17	Monmouth (U, Th, REE)	Skead Holdings Ltd.	2014	Pr	2.55827	Monmouth #182
18	Monmouth (U, Th, REE)	Skead Holdings Ltd.	2014–2015	Assay	2.55828	Monmouth #181
19	Monmouth (U, Th, REE)	Skead Holdings Ltd.	2014–2015	Assay	2.55810	Monmouth #180

Gold

CROWN WILLIAM MINING CORPORATION

In April and May 2015, Fladgate Exploration Consulting Company completed a program of surface stripping, trenching, channel sampling and georeferencing of historic diamond-drill hole collars for Crown William Mining Corporation on the Bannockburn gold project in Madoc Township. The objective of the program was to improve the understanding of the structure and controls on mineralization in the area of the original discovery zone and underground workings. The deposit, consisting of a complex series of quartz veins at a folded contact between mafic metavolcanic and metasedimentary rocks, contains a NI 43-101–non-compliant resource of 372 000 tons grading 0.395 ounces of gold per ton (Sawyer Consultants Inc. 1987).

Table 4. Exploration activity in the Southeastern Ontario District in 2015 (keyed to Figure 3).

Abbreviations

AEM	Airborne electromagnetic survey	Lc	Line cutting
AM	Airborne magnetic survey	Met	Metallurgical testing
ARA	Airborne radiometric survey	Micro	Microscope (mineral identification)
Beep	Beep Mat survey	OD	Overburden drilling
Bulk	Bulk sampling	ODH	Overburden drill hole(s)
DD	Diamond drilling	OMIP	Ontario Mineral Incentive Program
DDH	Diamond-drill hole(s)	OPAP	Ontario Prospectors Assistance Program
Enviro	Environmental base line survey	PEM	Pulse electromagnetic survey
GC	Geochemical survey	PGM	Platinum group metals
GEM	Ground electromagnetic survey	Pr	Prospecting
GL	Geological survey	RES	Resistivity survey
GM	Ground magnetic survey	Samp	Sampling (other than bulk)
GRA	Ground radiometric survey	Seismic	Seismic survey
Grav	Gravity survey	SP	Self-potential survey
HLEM	Horizontal loop electromagnetic survey	Str	Stripping
HM	Heavy mineral sampling	Tr	Trenching
IM	Industrial mineral testing and marketing	VLEM	Vertical loop electromagnetic survey
IP	Induced polarization survey	VLFEM	Very low frequency electromagnetic survey

No.	Company/Individual	Township/Area (Commodity)	Exploration Activity
1	Archibald, J.	Galway (Graphite)	Assay, GL, Str
2	Baird, D.	Kaladar (Au)	GC, Pr, GL
3	Crown William Mining Corp.	Madoc (Au)	Str, Tr
4	Danford Granite Ltd.	Elzevir (Trap Rock)	Samp, Bulk
5	Dubblestein, A.	Lyndoch (Graphite, Dolomite)	Str, Tr, GL
6	Forget, M.	Lyndoch (Graphite, Dolomite)	Str, Tr, GL, GC
7	Glanfield, M.	Barrie (Au)	Assay, Lc
8	JD Exploration Inc.	Hindon (Cu)	Micro
9	Lawrence, R.	Ashby (Kimberlite)	Assay, Pr
10	Lawrence, R.	Effingham (PGM, Au, Diamond)	Micro, Pr, Assay
11	McBride, D.; McBride, J.; Laidlaw, J.; Ryder, J.	Limerick (Base Metals, PGM)	GL, Pr
12	Skead Holdings Ltd.	Cardiff (U, Th, REE)	Pr, Assay
13	Skead Holdings Ltd.	Monmouth (U, Th, REE)	Pr, Assay
14	The Corporation of the Municipality of Highlands East	Monmouth (Mineral specimens)	Pr
15	Union Glory Gold Ltd.	Kaladar (Au)	DD
16	Waring, R.	Anglesea (Au)	Pr, Samp

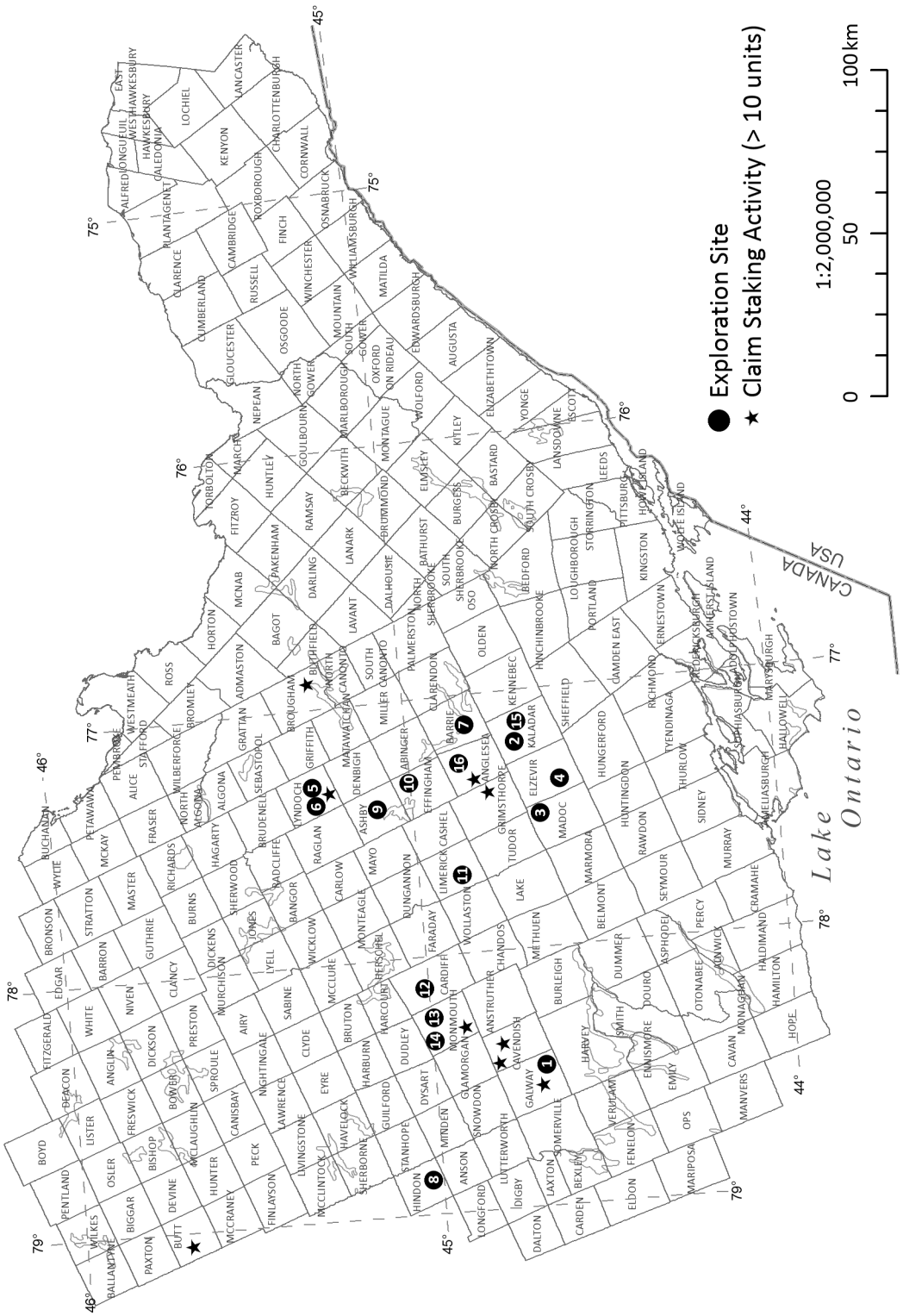

Figure 3. Exploration activity in the Southeastern Ontario District in 2015 (keyed to Table 4).

Results of the program include the identification of 4 sets of quartz veins, 2 of which are gold bearing (Photo 2); recognition of the importance of proximity to the volcanic–sedimentary rock contact as a vector to higher grades of gold mineralization within the veins; and discovery of several large veins that were not tested by previous diamond-drilling programs. Recommendations for future work include sampling of archived diamond-drill core; remodelling of the mineralized zone, incorporating new information on vein generations and structures; additional trenching and prospecting; and diamond drilling (Fingas 2015). In January 2016, the company began moving archived diamond-drill core stored at the Tweed Drill Core Library in preparation for a sampling program to continue in the spring of 2016 (J. Fingas, Fladgate Exploration Consulting Company, personal communication, January 2016).

UNION GLORY GOLD LIMITED

In June 2015, Union Glory Gold Limited completed 3 diamond-drill holes, totalling 400 m, on the Addington gold mine property in Kaladar Township. In 2013, the company completed a program of sampling of archived diamond-drill core stored at the Tweed Drill Core Library. Diamond drilling completed in 2015 was intended to both confirm results of previous drilling and to provide infill information. The company has not released the results of the 2015 drilling. Results of the 2014 work and a thorough description of the geology of the Addington Mine are documented by McBride (2013).

Prior to 1921, the Addington Mine produced about 480 ounces of gold from a quartz-tourmaline vein zone in arsenopyrite-bearing tuffaceous rocks between mafic metavolcanic rocks of the Tudor Formation and overlying clastic metasedimentary rocks of the Flinton Group. Five mineralized zones have been identified on the property with a combined, NI 43-101–non-compliant resource estimates of 160 000 t grading 5.16 g/t Au (measured); 130 000 t grading 5.63 g/t Au (indicated); and 425 000 t grading 3.79 g/t Au (inferred) (Johnson 1983 *in* McBride 2013).

Photo 2. Deformed, gold-bearing quartz vein with shallow eastward dip, in chloritic, volcaniclastic metasedimentary rock (UTM location 298085E 4947345N), Bannockburn property, Madoc Township; hammer is 35 cm long.

Graphite

Development of the Kearney and Bissett Creek deposits, which are 2 advanced-stage graphite projects in the Grenville Province, were stalled in 2015 because of a lack of financing, with the exception of test production of coated spherical graphite by Northern Graphite Corporation. The properties, briefly described below, are described in more detail by Sangster et al. (2014, p.15-17).

An option agreement by Valterra Resource Corporation on the Bobcaygeon graphite property of Earth Resources Ltd. was terminated in 2015 (Valterra Resource Corporation, news release, January 12, 2016). The property is described by Sangster et al. (2015, p.21).

Exploration on 2 graphite prospects in Lyndoch Township continued in 2016. Prospectors A. Dubblestein and M. Forget completed geological mapping, trenching and channel-sampling on the adjacent Little–Bryan and Malcolm prospects, respectively.

ONTARIO GRAPHITE LTD. – KEARNEY MINE

The Kearney Mine in Butt Township, near Huntsville, was first brought into production in 1989 and remained operational through 1994, during which time it achieved a peak production rate of 10 000 t per year of flake graphite product. The mine has been under new ownership and management since 2007. An NI 43-101 report, completed in October 2013, for Ontario Graphite Ltd., confirmed 51.5 million tonnes of Measured and Indicated Resources (2.14% Cg[7] average) and 46.8 million tonnes of Inferred Resources (2.0% Cg average) (www.ontariographite.com, under Kearney Mine | Fact Sheet).

NORTHERN GRAPHITE CORPORATION – BISSETT CREEK DEPOSIT

Northern Graphite Corporation (www.northerngraphite.com) continued the evaluation of the Bissett Creek graphite deposit in Maria Township. The property is located in northern Renfrew County, in the Southern Ontario Mining Division, but is approximately 2 km north of the boundary of the Southern Ontario Resident Geologist Region. In 2014, the company reported that it has amended the Preliminary Economic Assessment to reflect a doubling of the annual graphite production upon start-up rather than after 3 years of production as initially proposed. The new proposal calls for production of 44 200 t of graphite annually for the first 10 years (Northern Graphite Corporation, news release, June 24, 2014). In 2015, the company announced the successful production of coated spherical graphite for use as anode material in lithium ion batteries (Northern Graphite Corporation, news release, May 19, 2015).

A. DUBBLESTEIN – LITTLE–BRYAN PROSPECT

The Little–Bryan property, located in concessions VI and VII, lots 14 to 18, Lyndoch Township, is described by Sangster et al. (2015, p.31-35). Although staked as a graphite prospect, exploration done in 2013 and 2014, funded by an Ontario Exploration Corporation grant, resulted in the discovery of new exposures of high-purity, white, massive diopside; white diopside-dolomite; high-purity dolomite; and high-purity quartz. Exploration of these zones and of the graphite zone, through the use of a Beep Mat survey, stripping and channel sampling, continued in 2015. Stripping exposed the graphite zone in new areas both along and across strike, indicating a width of up to 20 m and strike length of at least 2 km on the Little–Bryan property (Forget 2016b).

In 2015, a portion of the claim group was optioned to Georgian Bay Marble and Stone, for the purpose of evaluating a zone of white, dolomitic marble for potential as dimension stone. The company proposes to

[7] "Cg" is a calculated value: graphite as carbon = total carbon less the amount of carbon present as CO_2.

extract several blocks of the marble as a bulk sample for testing purposes in 2016. Exploration on the remainder of the property will continue in 2016, to better define the known mineral zones and to prospect the area of an airborne time-domain electromagnetic (TDEM) anomaly parallel to and north of a similar anomaly over the known graphite zone (*see* Figure 6 in "Property Examinations") (A. Dubblestein, personal communication, September 2015).

M. FORGET – MALCOLM PROSPECT

The Malcolm prospect represents the westward strike extension of the Little–Bryan graphite zone. In 2014, M. Forget staked 4 claims, totalling 18 claim units, in concessions VI and VII, lots 19 to 24, Lyndoch Township. A first phase of exploration in May and June 2015, consisting of prospecting, Beep Mat surveying and mechanized stripping, resulted in the discovery of several graphite showings along the trend of a TDEM anomaly along strike from the Little–Bryan graphite prospect. This work was followed, in October 2015, by geological mapping, additional Beep Mat surveying, mechanized trenching and channel sampling, which resulted in the definition of a new zone of significant graphite mineralization. The geology of the property and results of the 2015 exploration are described in more detail under "Property Examinations", "Malcolm Graphite Prospect, Lyndoch Township" in this report.

Proposed work for 2016 includes additional stripping of the known graphite zone and exploration of a northern, parallel TDEM anomaly (*see* Figure 6 in "Property Examinations") (M. Forget, personal communication, January 2016).

RESIDENT GEOLOGIST STAFF AND ACTIVITIES

The Southern Ontario Regional Resident Geologist's office, located in Tweed, is the only Resident Geologist Program office south of the French River. The office is staffed by P.J. Sangster, *P.Geo*., Regional Resident Geologist; P.S. LeBaron, *P.Eng*., District Geologist; D.A. Laidlaw, *P.Geo.*, Regional Land Use Geologist; and S.J. Charbonneau, District Geological Assistant. A.C. Wilson, *P.Geo.*, Mineral Deposit Compilation Geologist—Northeastern Ontario, contributes to updates and review of the southern Ontario Mineral Deposit Inventory database. A detailed description of the activities of this position is included in this report (*see* "Mineral Deposit Compilation Geologist—Northeastern Ontario").

Additional support was provided by D. McColeman, Administrative Assistant (Acting), to the Senior Manager, Resident Geologist Program, Sudbury. Summer Experience Program student, E. Drummond, provided field season support.

The Resident Geologist Program monitors, stimulates and facilitates mineral exploration and the sustainable development of Ontario's mineral resources. Program services and functions are grouped into key areas including

- geological consultation and advisory services
- provision of public access to geoscience databases and other resource materials
- documentation of mineral exploration and development activity
- geoscience for land-use planning
- public education

The Southern Ontario Regional Resident Geologist's office also provides support to the ministry's Mineral Development and Lands Branch–Mining Lands Section front-counter client services and works with the MNDM Aboriginal Relations Branch to assist in fostering relations between the mineral industry and First Nation communities.

The Southern Ontario Regional Resident Geologist's office in Tweed offers public access to a complete library of Ontario Geological Survey publications for southern Ontario and a technical library of related publications. Diamond-drill core from industry and government projects across southern Ontario is available for examination with prior appointment.

In 2015, the project to convert all office files to a high-density system continued. To date, mineral deposit inventory files, assessment files, drill-core library, maps and technical papers have been incorporated. A library of industrial mineral references, formerly stored with the MNDM Mineral Development and Lands Branch in Sudbury is being indexed and filed for public access, as time permits.

The District Geological Assistant and the Summer Experience Student identified, scanned and re-organized over 3000 unique drill-core logs. Plans are to continue the scanning of unique, hard-copy documents from the office's mineral deposit inventory and assessment files in 2016.

Special Projects

In 2015, the District Geological Assistant participated in the Resident Geologist Program (RGP), Data Standards Working Group. The project aims to standardize the collection and distribution of various unique RGP data holdings in all offices across the province. The targeted data holdings include university theses, mine plans, drill-core logs, rock samples and photos. To date, all university theses have been catalogued in a database and a spatial index is to be distributed online through OGSEarth in 2016.

There are over 6000 mineral occurrences in southern Ontario documented in the Ontario Mineral Deposit Inventory (MDI) database. Staff of the Southern Ontario Regional Resident Geologist's office work with A.C. Wilson, Mineral Deposit Compilation Geologist—Northeastern Ontario, on an ongoing basis to ensure the integrity of the database. Site investigations to confirm the presence and accurate location of MDI data points are an essential part of the process. During the 2015 field season, visits were made to MDI locations in Cavendish, Dungannon, Faraday, Galway, Loughborough, Madoc, Marmora, Sebastopol and Tudor townships. In general, MDI records were validated; however, some locations were corrected based on new GPS readings.

First Nations Interactions

During 2015, activities co-ordinated by the Aboriginal Relations Branch included meetings with the Regional Resident and District geologists, Mineral Development and Lands Branch staff and First Nation representatives. Meetings were held with the Algonquins of Ontario, the Mississaugas of Scugog Island First Nation and the Sarnia First Nation. The District Geologist attended a site visit to exploration projects in Lyndoch Township with S.E. Halet, Mineral Exploration and Development Consultant for southern Ontario, and representatives of the Algonquins of Ontario.

Presentations

In February, a meeting was organized for a client group, including the Southern Ontario Prospectors Association, featuring updates on Mining Act Modernization, online staking and mining lands administration, presented by R. Denomme, Senior Manager, Mining Lands Branch. A second meeting was held for the same client group in May, featuring an update on the Mineral Development Strategy by R. Merwin, Executive Advisor to the Assistant Deputy Minister, and an overview of Ontario Geological Survey field projects for 2015 by R.M. Easton, Ontario Geological Survey, Earth Resources and Geoscience Mapping Section.

In March, staff assisted in the development and presentation of the Ontario booth at the Prospectors and Developers Association of Canada (PDAC) Annual Convention. The Regional Resident Geologist presented talks on "Ontario Critical Minerals – Inventory and Potential". The District Geologist attended the Northeastern Ontario Mines and Mineral Symposium in Kirkland Lake and presented a poster and samples highlighting recommendations for exploration for zinc and titanium-vanadium in southeastern Ontario.

In June, the District Geologist presented talks on "Ontario Geological Survey – Role and Responsibility" and "Geoscience, Minerals and Land Use Planning in Ontario" to a delegation of Chinese land-use planning students at Queen's University.

In August, the District Geologist gave a presentation to a delegation of Chinese scientists and industrialists on "Basalt in Ontario" as an overview of the potential for developing a basalt mineral fiber quarry and plant in Ontario. The presentation was part of a one-day seminar on the potential for research and investment collaboration in promoting basalt fiber applications in Canada and China, with emphasis on development opportunities in Ontario.

The District Geologist attended a one-day conference on minerals of the battery supply chain in September. The conference, organized by Benchmark Mineral Intelligence, featured presentations on the outlook for supply and demand of commodities, such as lithium, graphite and cobalt, for the high-performance battery market.

Mineral Shows, Outreach and Field Trips

Staff presented a poster and mineral display at the Bancroft Gemboree in August, highlighting the history of iron mining and the geological evolution of southern Ontario. The District Geologist gave a presentation on "The Geological History of Southern Ontario". The District Geologist presented the same display at the Picton Gem and Mineral Show in July.

In October, as part of the Ancaster Gem and Mineral Show, the District Geologist gave a series of talks to 240 elementary school students and, with the District Geological Assistant, provided a weekend-long poster and sample display.

Field trips to several marble quarries and gold prospects were provided by the District Geologist for the Scarborough Gem and Mineral Club in May; faculty and graduate students of the University of Toronto in June; the Kawartha Rock and Fossil Club in July; and a group of stone sculptors and lapidary enthusiasts in November. The District Geologist also assisted the Niagara Peninsula Geological Society in organizing a two-day field trip in August; accompanied staff of Mining Matters on a mineral collecting trip in July to obtain calcite, apatite and biotite for mineral education kits; and provided diamond-drill core samples and descriptions from a variety of southern Ontario exploration projects to the University of Waterloo for an educational display. In December, the District Geologist provided a field trip to several limestone dimension stone quarries in the Orillia, Peterborough and Kingston areas for an architectural consultant involved in the restoration of historic buildings at the Royal Military College in Kingston.

Diamond-Drill Core Collection

The Resident Geologist's Office (RGO) maintains an off-site diamond-drill core storage compound on Hunt Road, approximately 2 km south of the Village of Tweed. In addition to core stored on traditional core racks, the site houses over 200 000 m of irreplaceable drill core from southern Ontario stacked on pallets. A smaller collection of core, that is less likely to survive outdoor storage, is housed at the RGO facility in Tweed. In 2015, industry clients made 69 visits to the examine drill core in the RGO collection.

Table 5 provides a five-year summary of program activity and Table 6 lists new publications added to the Resident Geologist Program office technical library (in Tweed) during 2015.

Table 5. Program activity statistics (five-year summary) for the Southern Ontario Regional Resident Geologist's office.

Activity	2011	2012	2013	2014	2015
Field Investigations / Property Visits	42	45	45	39	36
Field Trips Given / Field Guides Written	3	2	3	3	6
MDI Records Revised	875	265	173	64	351
Presentations to Ministry of Municipal Affairs and Housing, Ministry of Natural Resources and Forestry, Ministry of Aboriginal Affairs	19	15	14	17	7
Clients Visits to RGP–Tweed Office	430	330	394	232	263
Drill Core Library Users	40	12	114	40	69
Client Communications / Interactions (Presentations/Poster Sessions)	>3000	>3000	>3000	>3000	>3000

Table 6. Library acquisitions in 2015 by the Southern Ontario District (publications of particular interest to the Southern Ontario District are shown in bold).

Title	Author(s)	Type and Year of Publication
Aggregate and Industrial Mineral Potential of the Guelph Formation, Southern Ontario	D.J. Rowell	Ontario Geological Survey, Open File Report 6307, 66p., 2015
Aggregate Resources Inventory of the Central and Eastern Parts of the District of Parry Sound, Central Ontario	D.J. Rowell	Ontario Geological Survey, Aggregate Resources Inventory Paper 69, 2015
Ambient Groundwater Geochemistry Data for Southern Ontario, 2007–2014	S.M. Hamilton	Ontario Geological Survey, Miscellaneous Release—Data 283–Revised, 2015
Drift Thickness Data (2015 Update) for the Caledon Village–Sleswick–Mono Mills Area, Regional Municipality of Peel, Southern Ontario	Ontario Geological Survey	Ontario Geological Survey, Aggregate Resources Inventory Paper 165–Revised, 2015 update to part of Map 165-2–Bedrock Resources, scale 1:50 000
Geological, Geochemical and Geophysical Data from the Ordovician Shales Drilling Program and the Regional Sampling Program, Southern Ontario	C. Béland Otis	Ontario Geological Survey, Miscellaneous Release—Data 326, 2015
Geology, Geochemistry and Mineral Potential of the Chenaux Gabbro, Northeastern Central Metasedimentary Belt, Grenville Province	B. Azar	Ontario Geological Survey, Open File Report 6299, 87p., 2015
Precambrian Geology of the Chenaux Gabbro, Grenville Province	B. Azar and R.M. Easton	Ontario Geological Survey, Preliminary Map P.3781, scale 1:20 000, 2015
Ground Gravity Survey, Residual of the Bouguer Anomaly, Central Simcoe County Area	Ontario Geological Survey	Ontario Geological Survey, Map 82 770 to Map 82 771, scale 1:50 000, 2015
Index to Published Reports, Maps and Digital Data, 2011–2014	Ontario Geological Survey	Ontario Geological Survey, Miscellaneous Paper 177, 67p., 2015
Geographic Index to Published Reports, Maps and Digital Data, 2011–2014	Ontario Geological Survey	Ontario Geological Survey, Miscellaneous Paper 178, 82p., 2015
Index to Maps, Bedrock Geology 1991–2014, Southern Sheet	Ontario Geological Survey	Ontario Geological Survey, scale 1:1 000 000, 2015
Index to Maps, Surficial Geology 1991–2014, Southern Sheet	Ontario Geological Survey	Ontario Geological Survey, scale 1:1 000 000, 2015

Title	Author(s)	Type and Year of Publication
Precambrian Geology of Eastern Ontario Interpreted from Aeromagnetic and Compiled Geological Data—Northwest Sheet	S.J. Magnus and R.M. Easton	Ontario Geological Survey, Preliminary Map P.3791, scale 1:100 000, 2015
Precambrian Geology of Eastern Ontario Interpreted from Aeromagnetic and Compiled Geological Data—Northeast Sheet	S.J. Magnus and R.M. Easton	Ontario Geological Survey, Preliminary Map P.3792, scale 1:100 000, 2015
Precambrian Geology of Eastern Ontario Interpreted from Aeromagnetic and Compiled Geological Data—South Sheet	S.J. Magnus and R.M. Easton	Ontario Geological Survey, Preliminary Map P.3793, scale 1:100 000, 2015
Report of Activities, 2014, Red Lake Regional Resident Geologist Report: Red Lake and Kenora Districts	A.F. Lichtblau, C. Ravnaas, C.C. Storey, A. Tims, R.L. Debicki, T.K. Pettigrew, A.C. Wilson and J. Wetendorf	Ontario Geological Survey, Open File Report 6301, 83p., 2015
Report of Activities, 2014, Thunder Bay North Regional Resident Geologist Report: Thunder Bay North District	G.D. White, R.M. Cundari, M.R. Brunelle, T.K. Pettigrew, A. Tims and R.L. Debicki	Ontario Geological Survey, Open File Report 6302, 54p., 2015
Report of Activities, 2014, Thunder Bay South Regional Resident Geologist Report: Thunder Bay South District	M.A. Puumala, D.A. Campbell, A. Tims, R.L. Debicki, T.K. Pettigrew and M.R. Brunelle	Ontario Geological Survey, Open File Report 6303, 75p., 2015
Report of Activities, 2014, Timmins Regional Resident Geologist Report: Timmins and Sault Ste. Marie Districts	P. Bousquet, A. Pace, C.M. Daniels, R.L. Debicki, A.C. Wilson, A. Samuel and A. Yukich	Ontario Geological Survey, Open File Report 6304, 83p., 2015
Report of Activities, 2014, Kirkland Lake Regional Resident Geologist Report: Kirkland Lake and Sudbury Districts	D.L. Guindon, D.G. Farrow, J. Suma-Momoh, C.M. Daniels, R.L. Debicki, A.C. Wilson, L.A.F. Hall and N. Sabiri	Ontario Geological Survey, Open File Report 6305, 83p., 2015
Report of Activities, 2014, Southern Ontario Regional Resident Geologist Report: Southeastern Ontario and Southwestern Ontario Districts and Petroleum Operations	P.J. Sangster, P.S. LeBaron, S.J. Charbonneau, D.A. Laidlaw, R.L. Debicki, A.C. Wilson and L. Fortner	Ontario Geological Survey, Open File Report 6306, 69p., 2015
Results of 2011–13 Overburden Drilling Programs in the Southern Part of the County of Simcoe, South-Central Ontario	A.F. Bajc, R.P.M. Mulligan, D.R.B. Rainsford and J.L. Webb	Ontario Geological Survey, Miscellaneous Release—Data 324, 2015
Summary of Field Work and Other Activities, 2015	Ontario Geological Survey	Ontario Geological Survey, Open File Report 6313, 488p., 2015
Upper Ordovician Organic-Rich Mudstones of Southern Ontario: Drilling Project Results	C. Béland Otis	Ontario Geological Survey, Open File Report 6312, 59p., 2015
Workshop Summary and Gap Analysis Report: Unifying Groundwater Science in Southern Ontario	H.A.J. Russell, E.H. Priebe and J.R. Parker	Ontario Geological Survey, Open File Report 6310, 64p., 2015
Hypogene Zinc Silicates, Oxides and Sulfides in Mesoproterozoic Grenville Supergroup Marbles of the Bryson–Renfrew Region (Quebec and Ontario): Distribution and Genetic Significance	J.F. Larivière	PhD thesis, Université du Québec à Montréal, 2012
Introduction to Remote Sensing; Third Edition	J.B. Campbell	The Guilford Press, New York, 2002
Petrogenesis of the White Lake Pluton	G.H. Somers	MSc thesis, University of Western Ontario, 1984
The Geochemistry of the Marmoraton Fe Skarn and Associated Syenodiorite Intrusion, Grenville Province, S. Ontario	S. Mathur	MSc thesis, University of Toronto, 2015
The Precursor Principle and the Possible Significance of Stratiform Ores and Related Chemical Sediments in the Elucidation of Processes of Regional Metamorphic Mineral Formation	R.L. Stanton	Philosophical Transactions of the Royal Society of London, Series A, v.328, no.1602, p.529-646, 1989

PROPERTY EXAMINATIONS

In 2015, a total of 36 properties in the Southern Ontario Region were visited by Resident Geologist Program staff; these visits are listed in Table 7.

Table 7. Property visits conducted by the Southern Ontario Regional Resident Geologist and staff in 2015 (keyed to Figures 4 and 5).

Number	Property / Operation	Commodity
	Southeastern Ontario District	
1	Addington Mine, Union Glory Gold Ltd., Kaladar Township	Gold
2	Bass Lake (Bobcaygeon) property, Valterra Resource Corp., Cavendish Township	Graphite
3	Bath East roadcut, Ernestown Township	Scientific interest (stromatolites)
4	Bridgewater Quarry, Danford Granite, Elzevir Township	Trap rock
5	Canada Talc mine site, Sherritt International, Huntingdon Township	Scientific interest (talc, nephrite, stromatolites)
6	Coloured Aggregates, Marmoraton Mill site, Marmora Township	Specialty aggregate
7	Coloured Aggregates site, Highwood Resources core dump, Marmora Township	Nephrite
8	Dingman prospect, California Gold Mining Inc., Marmora Township	Gold
9	Dostanko pits, Marmora Township	Sulphides, marble
10	Frontenac lead mine, Loughborough Township	Mineral specimens (galena, calcite)
11	Gilmour Fluorite, Tudor Township	Marble, fluorite (mineral specimen)
12	Havelock Quarry, Drain Bros. Excavating Ltd., Belmont Township	Trap rock
13	Highway 62 East Quarry, Tudor Township	Marble
14	Little–Bryan, A. Dubblestein claims, Lyndoch Township	Graphite, dimension stone
15	Loom Lake property, Valterra Resource Corp., Galway Township	Graphite
16	Madoc project, Crown William Mining Corp., Madoc Township	Gold
17	Malcolm prospect, M. Forget claims, Lyndoch Township	Graphite
18	Mann Lake project, G. Baciu claims, Lake Township	Talc, marble
19	McMillan Quarry, Dungannon Township	Marble
20	Methuen Quarry, MRT Aggregates Inc., Methuen Township	Trap rock
21	Ore Chimney prospect, Barrie Township	Gold
22	Parnell Quarry, Galway Township	Dimension stone
23	Perry Lake fluorite mine site, Huntingdon Township	Fluorite (mine rehabilitation)
24	R. Waring claims, Anglesea Township	Gold
25	Redstone Quarry, Galway Township	Dimension stone
26	Royal Military College, Kingston (restoration of limestone buildings)	Dimension stone, restoration study
27	Smart Occurrence (Miller Property), Sebastopol Township	Mineral specimens (apatite, biotite)
28	Stewart Quarry, Dungannon Township	Dimension stone
29	Stonescape Quarry, Harvey Township	Dimension stone
30	Tatlock Quarry, OMYA Canada Ltd., Darling Township	Calcium carbonate
31	Temagami Pink Quarry, W. Graf, Faraday Township	Dimension stone
32	Tweed Marble Quarry, Hungerford Township	Dimension stone
33	Upper Canada Stone, green marble quarry, Huntingdon Township	Stone, scientific interest
34	Upper Canada Stone plant, Madoc Township	Decorative aggregate, landscaping stone
	Southwestern Ontario District	
35	Longford Quarry, Rama Township	Dimension stone
36	Rockleith Quarry, Orillia Township	Dimension stone

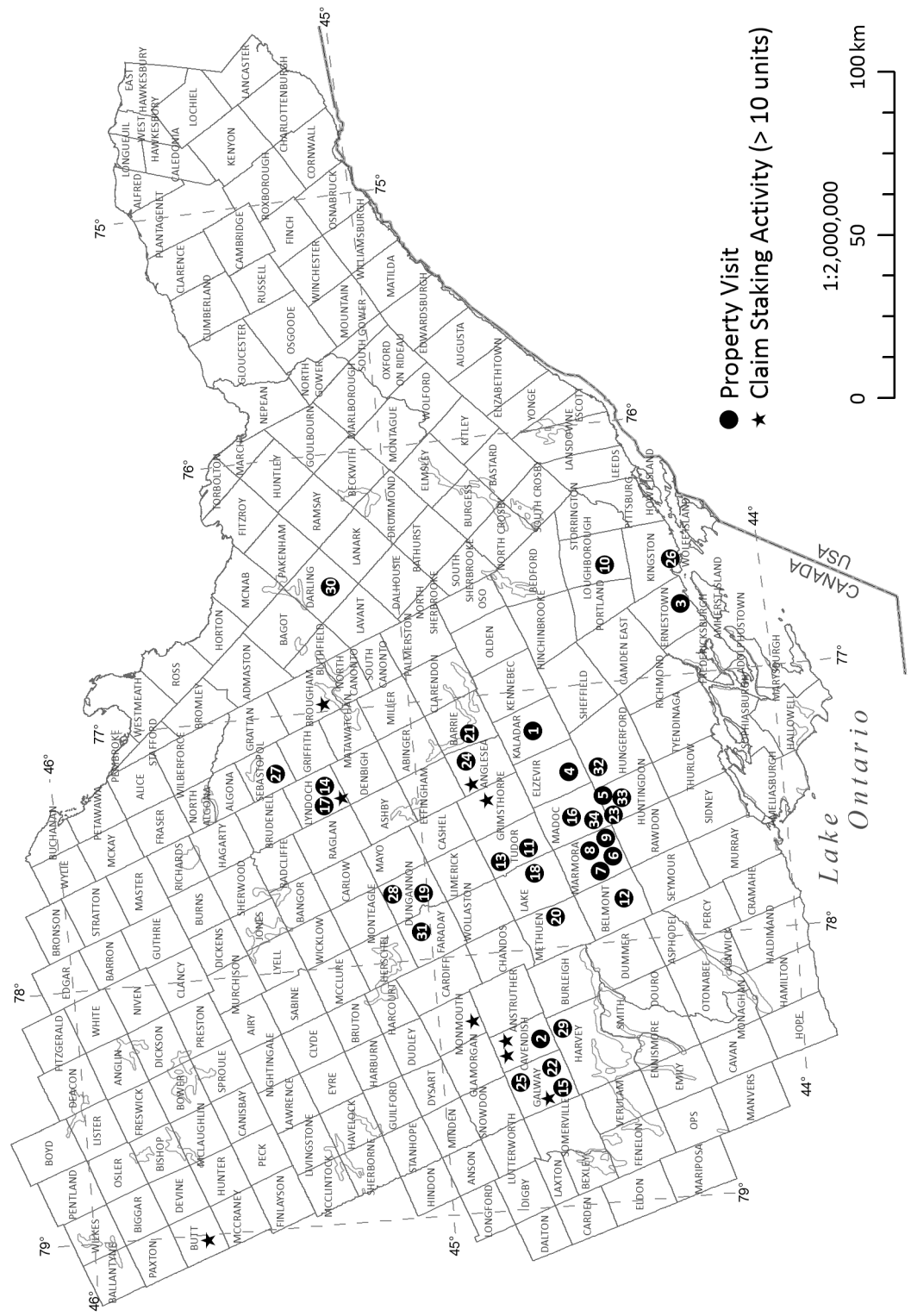

Figure 4. Property visits (keyed to Table 7) and claim staking activity in the Southeastern Ontario District in 2015.

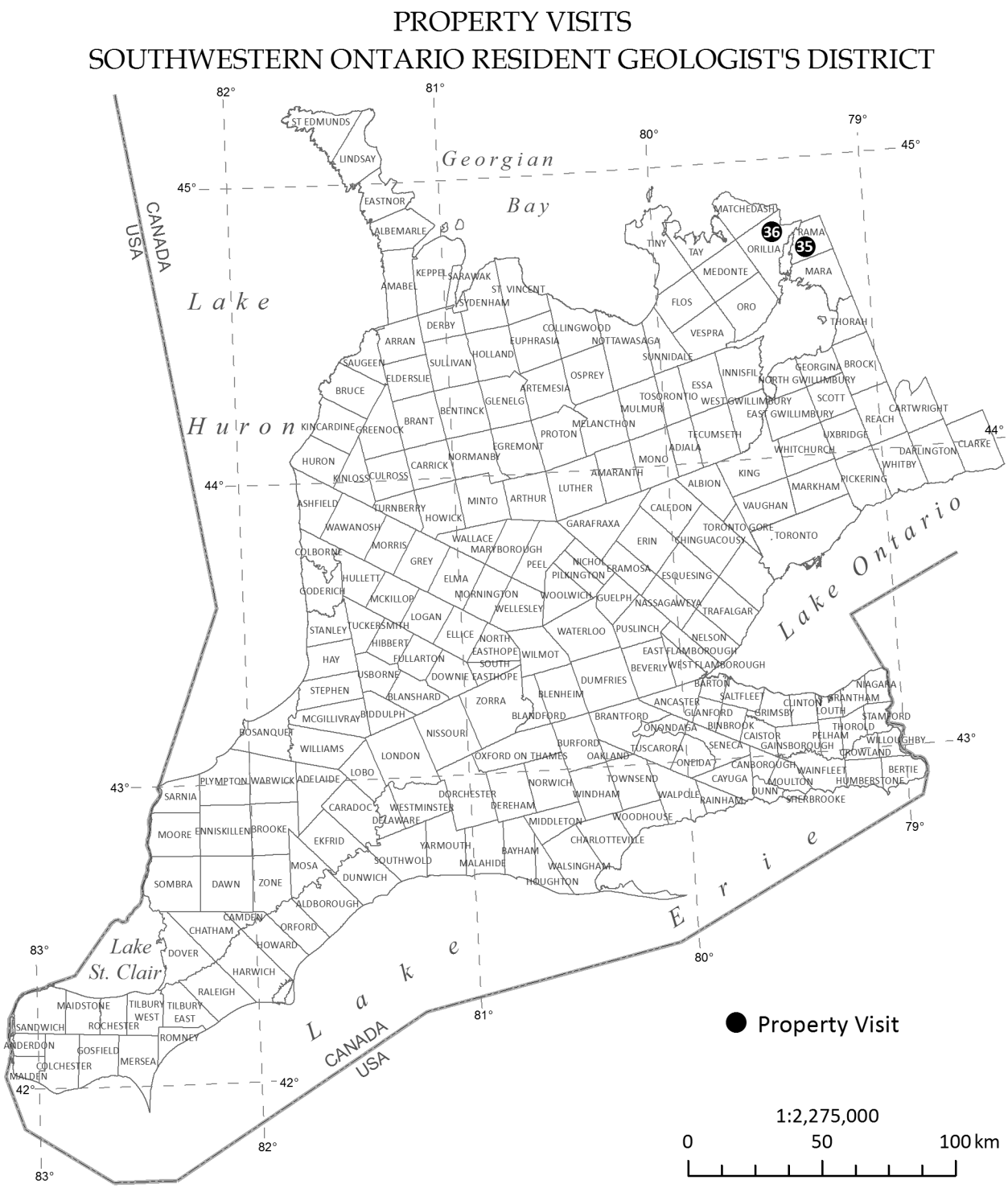

Figure 5. Property visits (keyed to Table 7) in the Southwestern Ontario District in 2015.

Malcolm Graphite Prospect, Lyndoch Township

On November 20, 2015, the District Geologist accompanied M. Forget on an examination of his graphite prospect in Lyndoch Township. The property, consisting of 4 claims totalling 18 units, was staked in 2014 and 2015 to cover the western extension of 2 airborne TDEM anomalies (Figure 6), the more southerly of which is associated with graphite-pyrrhotite mineralization on the adjacent Little–Bryan property, described by Sangster et al. (2014, p.33-38). Two phases of exploration work were completed in 2015, funded by an Ontario Exploration Corporation grant. The first phase, in May and June, consisted of prospecting, Beep Mat surveying and mechanized stripping, followed by the second phase, in October, consisting of geological mapping, additional Beep Mat surveying, mechanized trenching and channel sampling.

LOCATION AND ACCESS

The group of 18 mining claim units is located in concessions VI and VII, lots 19 to 24, Lyndoch Township.

Access is by Highway 28 east from Bancroft to Schutt Road; north to Road 515, east to Quadeville; 6 km south on Addington Road to Hyland Creek Road; continue 2 km south to the Graham Lake access road, and follow it east for 2.5 km to the centre of the claim group.

EXPLORATION HISTORY

The area has been explored sporadically since the late 1800s. Hewitt (1953) and Hewitt and Carlson (1954) document occurrences of beryl, copper, corundum, feldspar, gold, graphite, iron, molybdenum, rare earth elements and radioactive minerals in the Brudenell–Raglan area, including Lyndoch Township.

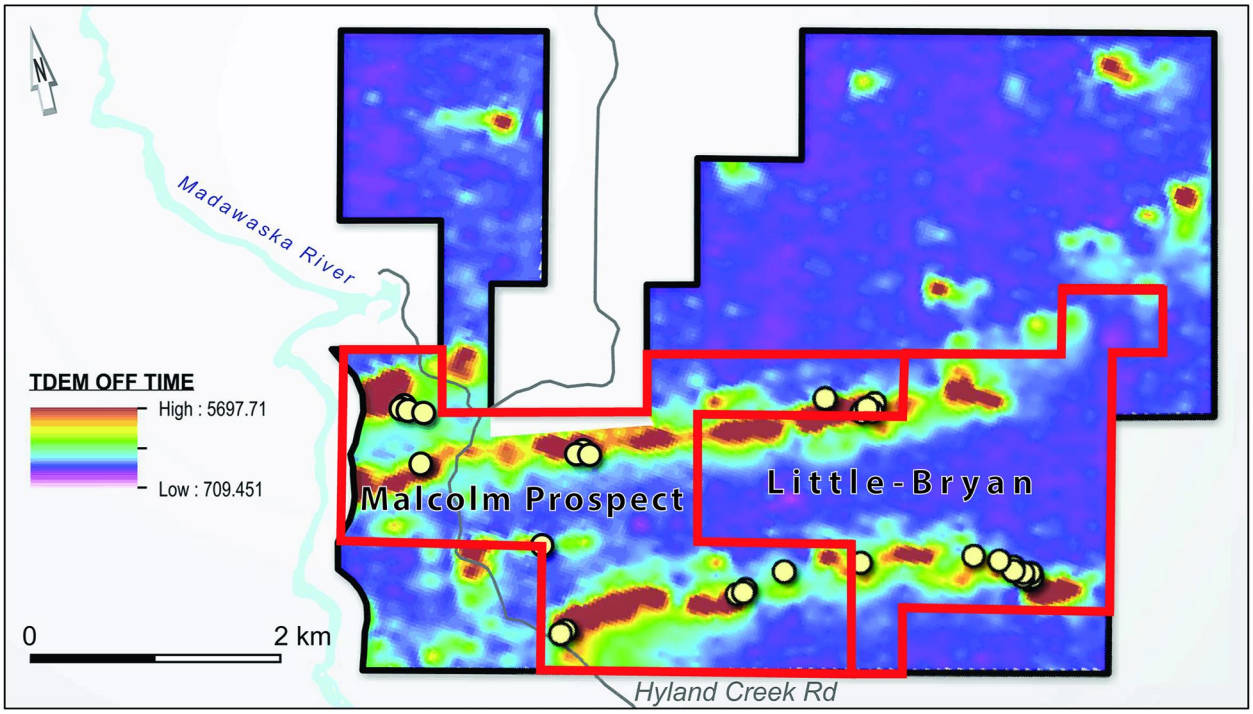

Figure 6. Results of an airborne time-domain electromagnetic (TDEM) survey, conducted by Standard Graphite Corp., showing linear conductive zones, graphite-bearing sample locations (yellow circles outlined in black) and the location of the Malcolm and Little–Bryan claim blocks (outlined in red) (*modified from* Standard Graphite Corp., news release, February 21, 2012, www.standardgraphite.com, under News | 2012).

The most significant base metal occurrence in the area, the Simon copper prospect, is located about 7 km south of the Malcolm property. It contains 250 000 t grading 1.1% Cu, hosted by metasedimentary rocks in contact with metavolcanic rocks and has been interpreted as either a sedimentary exhalative (SEDEX) or volcanogenic massive sulphide (VMS) deposit (Taner 2008).

L. Malcolm staked the property as a copper prospect in 1961and optioned the property to Prospectors Airways Limited. The company completed a VLF–EM survey that delineated a conductive zone with a strike length of over 2 km (Pearson 1963).

In 1965, W.H. Morrison completed 1 diamond-drill hole in Concession VI, south half of Lot 24, Lyndoch Township. A 12 m wide graphite-pyrrhotite zone was intersected, but no graphite analyses were reported (Hobbs 1965).

In December 2011 and January 2012, Standard Graphite Corp. completed an airborne time-domain EM (TDEM) survey covering both the Little–Bryan and the Malcolm prospects (Desaulniers 2012). The survey identified a conductor coinciding with the Little–Bryan graphite zone and a second near-surface conductive trend lying approximately 1 km to the north, both extending several kilometres to the west through the Malcolm prospect claim group (*see* Figure 6).

In April 2012, MPH Consulting Limited completed a reconnaissance sampling program on the TDEM conductors located by the Standard Graphite Corp. TDEM survey, confirming graphite mineralization in both the northern and southern conductors on the Malcolm property (Sobie 2012).

EXPLORATION PROGRAM 2015

Exploration of the property in 2015 began on the southern TDEM conductor in May and June. A base line was established along the axis of the anomaly using UTM co-ordinates extracted from the TDEM profiles. A Beep Mat survey and prospecting were done along 175 m cross-traverses at 50 m intervals along the base line. Conductive zones identified by the Beep Mat survey were flagged and stripped to bedrock using a small excavator. Graphite mineralization was exposed in several locations over a 2.4 km strike length and saw-cut channel samples were taken, resulting in assays of up to 10% Cg. One sample that contained 8.5% Cg did not respond to the Beep Mat and it was recognized that systematic stripping along the TDEM conductor was required to properly evaluate the graphitic zone (Forget 2015).

A subsequent phase of stripping, washing, channel sampling and detailed geological mapping was completed on the southern TDEM conductor in October 2015 and limited reconnaissance prospecting in August 2015 confirmed the presence of graphite mineralization associated with the northern TDEM conductor (Forget 2016a).

REGIONAL GEOLOGY

The property lies within the Bancroft terrane of the Central Metasedimentary Belt, an area dominated by calcitic and dolomitic marbles and quartzofeldspathic gneisses derived from siliceous, clastic sedimentary rocks. Plutonic rocks consist of tonalite-granodiorite and gabbro-diorite-syenite-granite complexes. Syenitic and nepheline syenitic gneisses are widespread, as are skarns and pegmatites associated with a late suite of carbonatitic rocks and fenites.

The geology in the area of Lyndoch Township, as mapped by Lumbers (1982), consists of a northeasterly trending belt of calcareous metasedimentary rocks flanked by alkalic granitic and syenitic intrusive rocks to the north and by an older biotite diorite suite of intrusive rocks (gabbro, diorite, syenite and granite of the Slate Falls Complex) to the south (Figure 7).

The area hosts a variety of mineral occurrences. Molybdenite is associated with skarns and pyritic zones at contacts between marble and diorite, syenite and pegmatite intrusions. Magnetite skarns occur at the margins of gabbro, diorite and syenite intrusions. Base metals are associated with dolomitic marbles and siliceous metasedimentary rocks, such as at the Renprior zinc prospect (sphalerite) in Admaston Township and near metasedimentary–metavolcanic rock contacts, such as at the Simon copper prospect (chalcopyrite, sphalerite). Graphite is associated with both marbles and siliceous, rusty schists and gneisses.

PROPERTY GEOLOGY

Although the Malcolm property has not been completely mapped and most of the exploration work done in 2015 was limited to the immediate area of the southern TDEM conductor, the geology of the property is expected to be similar to that of the Little–Bryan prospect, along strike to the east. As described by Sangster et al. (2014), the southern conductive (graphite-pyrrhotite) zone occurs within a southerly dipping sequence of metasedimentary rocks, including calcitic and dolomitic marble and hornblende-quartz-feldspar-biotite paragneiss. The graphite-pyrrhotite unit appears to be associated with a transition zone between the carbonate-rich units to the north and siliceous paragneiss to the south. A significant difference between the graphite mineralization observed on the Malcolm and the Little–Bryan properties is that the Malcolm zone includes marble-hosted graphite with little to no pyrrhotite in addition to the quartz-rich, rusty, graphite-pyrrhotite-bearing gneiss of the Little–Bryan zone.

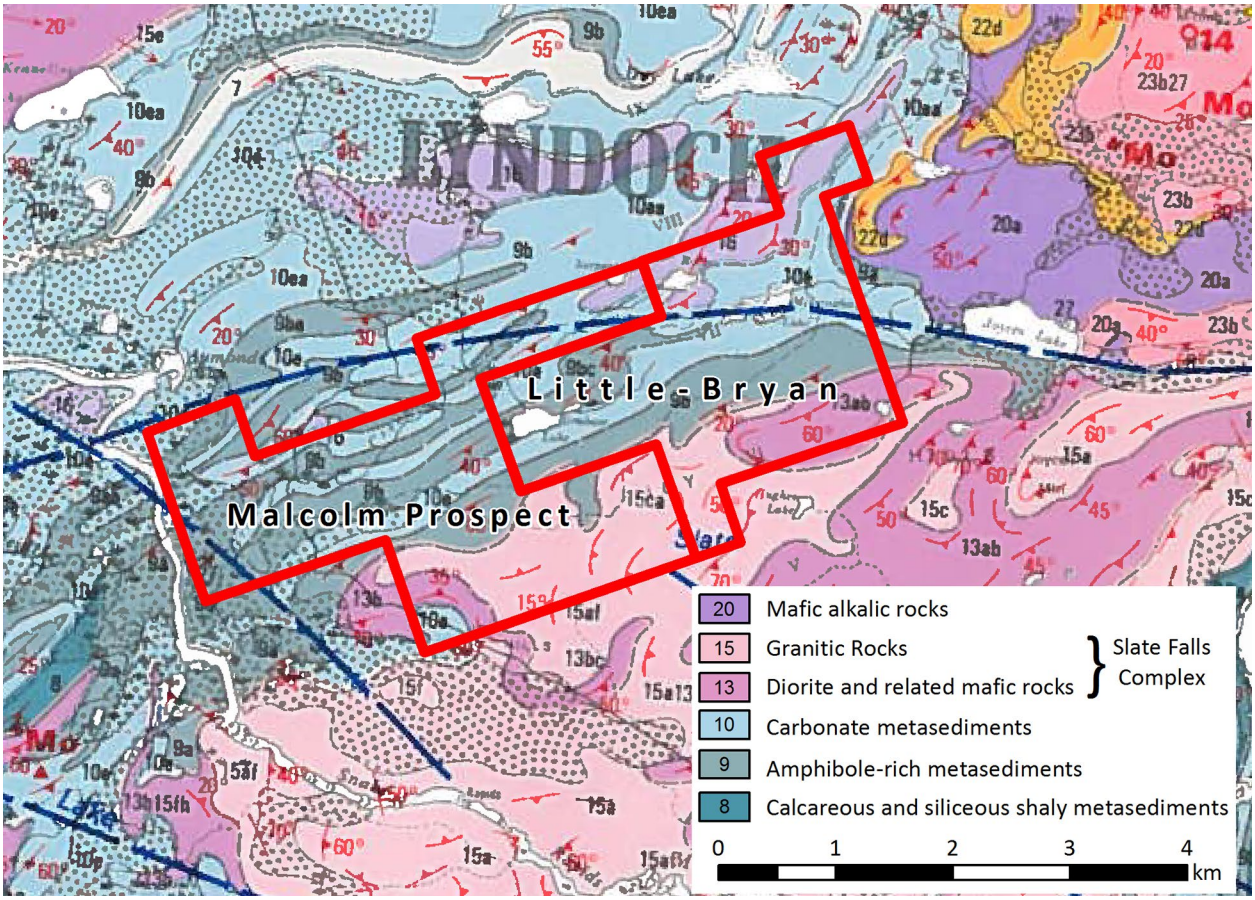

Figure 7. Geology in the area of the Malcolm and Little–Bryan graphite prospects, Lyndoch Township (geology *from* Lumbers 1982).

Graphite

With the exception of references to graphite occurring with pyrrhotite in gneiss and marble in the 1965 diamond-drill hole of W.H. Morrison (Hobbs 1965), the only previous record of graphite mineralization on the Malcolm property is that of MPH Consulting Limited, which reported several assays of up to 9.81% Cg from grab samples collected during reconnaissance prospecting of the TDEM conductors (Sobie 2012). Exposure of the graphite zone by stripping in the 2015 exploration program by M. Forget represents a significant new graphite occurrence.

Attempts to locate the graphite zone in the West zone (Concession VI, lots 22 to 24) of the property were unsuccessful because of the depth of overburden. In the Central zone (Concession VI, lots 20 and 21), graphite mineralization was exposed in 7 of 8 trenches along the north and south margins of an easterly trending swamp, within an area about 100 m long and 40 m wide. Disseminated flakes of graphite occur in a friable, granular, quartz-rich, gossan zone. The gossan may be a result of very fine-grained pyrite and/or iron carbonate content, as the rock is non-magnetic and pyrrhotite appears to be absent. In trench 1, on the north side of the swamp, the mineralized zone dips below the swamp to the south (Photo 3). Footwall rocks to the north were not exposed because of thick overburden. Trenches 3 and 4, about 60 m east of trench 1 and on the south side of the swamp, expose the graphite zone in friable, sandy, dolomitic marble. Both exposures suggest that the zone is continuous below the swamp and that the trenches have exposed the northern and southern margins of the zone.

Forget (2016a) reports the following graphite analyses of channel samples taken across the strike of the Central zone.

	Average Cg (%)	Width of Channel (m)
Trench 1	3.07	8.0
Trench 2	2.97	7.0
Trenches 3 and 4	2.05	10.0
Trenches 5 and 6	3.13	10.0

Photo 3. Malcolm property, trench 1 (UTM 316602E 5014150N), showing graphitic gossan zone along the north margin of the Central zone swamp; inset shows gossan zone with grey, graphite-rich material in white, granular quartz.

The East zone (Concession VI, Lot 19) is exposed in a pit within an extension of the Central zone swamp, about 800 m east of the Central zone trenches and close to the boundary with the Little–Bryan claim group to the east. At the time of the property examination, the pit, about 9 m in diameter, was mostly filled with water, but the graphite zone was exposed in both the north and south walls. The average grade of channel samples taken across a width of 9.0 m is 6.15% Cg (Forget 2016a). Total width of the zone in this area is unknown, as the footwall and hanging-wall rocks were not exposed during trenching.

SUMMARY

Exploration in 2015 has identified a previously unexplored graphite zone of significant width and strike length averaging from 2 to 6% Cg. Trenching has exposed a mineralized zone up to 40 m wide at intervals along a strike length of at least 1 km, associated with an airborne TDEM anomaly that extends an additional 1.2 km across the property.

Limited reconnaissance prospecting has also located graphite mineralization along a second, parallel TDEM anomaly about 1 km north of the known graphite zone. Exploration work proposed for 2016 includes detailed mapping and sampling of the northern zone and additional trenching on the southern zone (M. Forget, Prospector, personal communication, January 2016).

Waring Creek Gold Prospect, Anglesea Township

On December 4, 2015, the District Geologist and the Geological Assistant accompanied R. Waring on a geological examination of his gold prospect in Anglesea Township, part of a large claim group that extends southwestward into Grimsthorpe Township (Figure 8). The area examined is in the vicinity of Killer Creek in concessions XII and XIII, lots 25 and 26.

LOCATION AND ACCESS

The Waring Creek project area consists of 75 mining claims, totalling 679 claim units staked by R. Waring in 2014 and 2015, and is located about 40 km north of Tweed. Access to the northern part of the project area is by the Hughes Landing Road, leading westward 10 km from Highway 41 at Cloyne, and an additional 10 km westward on logging roads to the claim group.

EXPLORATION HISTORY

Although arsenopyrite occurrences with minor gold content were discovered in the eastern part of Anglesea Township in the early 1900s, very little exploration work has been recorded in the area of the Waring Creek property prior to the 1980s.

In 1986, reconnaissance prospecting by United Reef Petroleums Limited resulted in the discovery of gold mineralization in the northwestern corner of Concession XIV, Lot 27, about 1 km northwest of the property visit area (*see* Figure 8: location 15 with “Au” symbols). An assay of 0.19 ounce gold per ton (6.3 g/t Au) was obtained from a grab sample of a felsic rock unit at least 3 m wide that is in contact with rusty, mafic metavolcanic rocks (Johnson 1988). The company subsequently staked a group of 20 claims in concessions XIII to XV, lots 25 to 28, covering part of the present Waring Creek project area, and completed magnetometer and VLF–EM geophysical surveys, trenching and stripping (Johnson 1988).

In 1989, H. Dowhaluk began a reconnaissance mapping and prospecting program in the area of the United Reef Petroleums discovery. After a sample from a narrow quartz vein returned an assay of 0.674 ounce gold per ton (22.5 g/t Au), he staked a group of 12 claims in concessions XII and XIII, lots 25 to 28, and completed magnetometer and VLF–EM surveys, geological mapping and hand stripping.

REGIONAL GEOLOGY

The geology and mineral occurrences of Grimsthorpe Township and the western part of Anglesea Township are described by Easton and Ford (1994). The most recent geological map of the area by the Ontario Geological Survey (Easton 2001) includes the northern part of the Waring Creek project area (*see* Figure 8). The following description of the geology of the area is summarized *from* Easton and Ford (1994).

The project area lies within the Grimsthorpe domain of the Elzevir terrane in the Central Metasedimentary Belt. The stratigraphic sequence consists of older tholeiitic mafic metavolcanic rocks and intrusions of the

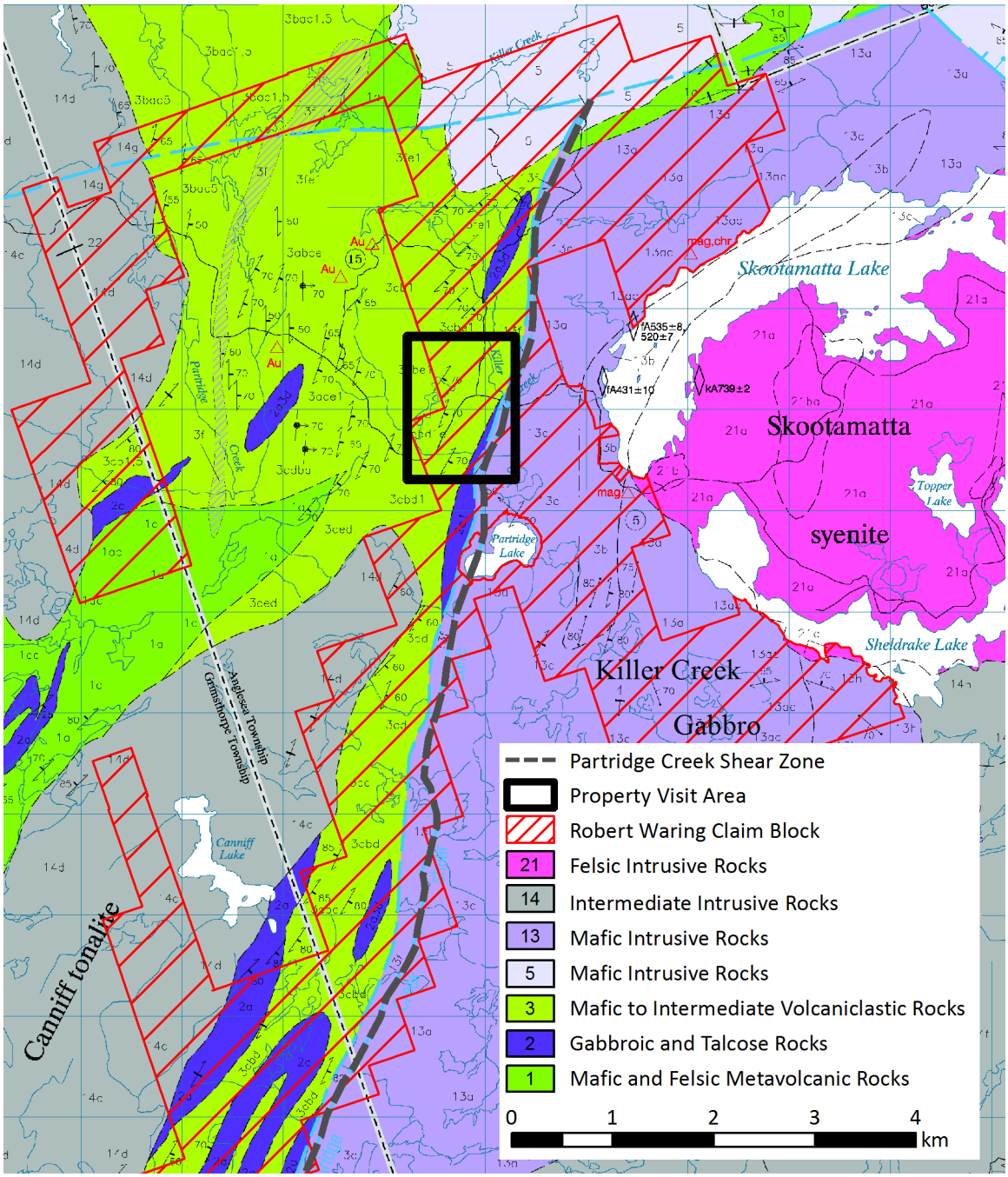

Figure 8. Location and geology in the area of the Waring Creek project, Anglesea and Grimsthorpe townships, showing the area examined during the December 2015 property examination (geology *from* Easton 2001).

Canniff Complex, overlain by a younger sequence dominated by volcaniclastic rocks of the Grimsthorpe Group. The metavolcanic rocks have been intruded by the Killer Creek gabbro, which was in turn intruded by the Elzevir tonalite (1270 Ma) and the Skootamatta syenite (1085 Ma). The Canniff and Weslemkoon tonalites (Elzevir suite) also intruded the metavolcanic sequence.

A series of older, protomylonitic gabbros and metavolcanic rocks occurs within the Canniff Complex along the margin of the Canniff tonalite. Several talc occurrences are hosted by these gabbros in a narrow belt along the southern and western margins of the Elzevir tonalite. Easton and Ford (1994) suggest that, based upon field and geochemical observations, the Canniff Complex may represent a partially preserved ophiolite fragment that predates the Grenville Supergroup.

The Partridge Creek shear zone (PCSZ), a north-northeast-trending deformation zone up to 100 m wide, follows the western margin of the Killer Creek gabbro.

PROPERTY GEOLOGY

In the area of the property examination, the PCSZ separates mafic metavolcanic and volcaniclastic rocks to the west from the Killer Creek gabbro to the east. Several quartz vein occurrences were examined, all of which are hosted by the metavolcanic rocks within about 600 m of the PCSZ.

A quartz vein up to 40 cm wide occurs in strongly sheared, brecciated volcaniclastic rock exposed in the side of a small gravel pit (UTM 315488E 4966754N) adjacent to the access road. The host rock exhibits strong chlorite-sericite alteration and a yellow-brown gossan as a result of pervasive iron carbonate alteration. The quartz varies from clear and glassy to smoky grey, with yellow and brown iron oxide coating and staining. Only trace amounts of pyrite were observed. This is the location of the "gravel pit vein" described by Dowhaluk (1991, p.13), who reported an assay of 0.674 ounce gold per ton (22.5 g/t Au) from a grab sample of vein material. R. Waring reported an assay of 66.6 g/t Au from the same quartz vein (Waring 2016). Analytical results of samples taken by the District Geologist are pending. The host rocks strike 340° and dip 85° to the east; the crosscutting quartz vein strikes 110° and dips 30° south. A series of parallel quartz veins, less than 1 cm thick and spaced 2 to 10 cm apart, is exposed in the 1 m thickness of the outcrop. Additional stripping would be useful in determining the extent of the vein system.

About 500 m northeast of the gravel pit vein, roughly along strike of the metavolcanic rocks, rusty quartz veinlets up to 2 cm wide occur in sheared, volcaniclastic rock containing a narrow (5 cm) seam of chloritic, friable fault gouge. Angular blocks of quartz vein material up to 15 cm wide in rusty, sheared metavolcanic rock are also present on surface at this location (UTM 315710E 4967142N).

On the northeast side of a small creek, an additional 500 m to the northeast (UTM 315973E 4967441N), a 50 cm wide quartz vein is exposed in a trench in which numerous blocks of similar quartz were observed in sandy overburden that contains abundant chlorite and phlogopite grains. The vein material is white to smoky quartz with iron oxide staining and rare seams and patches of pyrite. The wallrock is a strongly foliated, chloritic, mafic metavolcanic rock. R. Waring obtained an assay of 13.3 g/t Au from a grab sample of quartz vein material at this site (Waring 2016). The east-trending creek follows a topographic low: one of several similar topographic features that may represent cross faults associated with the northerly trending PCSZ. Waring (2016) reported gold assays of 1.38 and 0.39 g/t Au from quartz veins within the area of another east-trending creek about 600 m south of the gravel pit vein (not visited during this property examination).

About 250 m north of the previous site, an outcrop of strongly foliated, chloritic mafic metavolcanic rock contains pervasive iron carbonate alteration and narrow quartz veinlets parallel to foliation. No sulphides were observed. About 40 m northeast of the previous outcrop, mafic metavolcanic rocks contain a network of fine (1–2 mm) quartz-carbonate veinlets.

MINERAL POTENTIAL

The sites examined during the property visit exhibit evidence of strong deformation, carbonate alteration, quartz veining and local sulphide mineralization, possibly associated with hydrothermal activity focussed by the PCSZ. Topographic lows, roughly east trending, may represent cross faults at intervals along the PCSZ. Gold mineralization occurs in rusty, smoky quartz veins within sheared metavolcanic rocks, possibly associated with east-trending cross structures in the vicinity of the PCSZ. However, additional stripping of the quartz vein zones is required to determine the orientation and extent of the vein structures.

The Waring Creek project area covers a considerable extent of the Partridge Creek shear zone (PCSZ) (*see* Figure 8), which has had very little previous exploration for gold. In addition to the potential for gold mineralization in the metavolcanic rocks to the west of the PCSZ, the shear zone itself deforms both volcanic and mafic intrusive rocks and may make an interesting target for gold. The presence of tuffaceous conglomerates and intercalated rusty schists within the volcaniclastic sequence of the Grimsthorpe Group may also indicate potential for volcanogenic massive sulphide mineralization (Easton and Ford 1994).

RECOMMENDATIONS FOR EXPLORATION

Nephrite Jade in Southeastern Ontario

BACKGROUND

In 2014, a sample collected from the waste rock pile of the Canada Talc Mine in Madoc by the Regional Resident Geologist in 2010 was confirmed as nephrite jade. The sample, Cantal-14-1, originally thought to consist of very fine-grained, pale green serpentine and tremolite, was analyzed by X-ray diffraction (Fernandes 2014) and found to consist entirely of tremolite.

Petrographic thin section studies were subsequently done on the sample, on an additional sample of waste rock from the mine and on 2 samples of green, tremolitic marble from sites along the same marble belt that hosts the Canada Talc deposit; all samples were collected in 2014 by staff of the Southern Ontario Regional Resident Geologist's Office. The results confirm the presence of nephrite jade from the Canada Talc Mine site and that the green marbles contain 88% and 94% tremolite (Wilson 2014). Additional samples of nephrite-bearing marble were found by Southern Ontario RGO staff in a pile of dumped diamond-drill core at the site of the former Canada Talc Mine processing plant in Marmora. The holes were drilled in 1986 and 1987 to test for down-dip extensions of the talc zone. The absence of fractures in the drill-core samples suggests that fracturing in sample Cantal-14-1 is the result of blasting during the talc mining operations (Photo 4) and that zones of nephrite away from the mine workings may be relatively unfractured.

In August 2010, Sherritt International announced the closure of the company's Canada Talc Mine. At the time of its closure, the Canada Talc Mine was the longest continuously operating underground mine in North America, having opened as the Henderson Mine in 1896. The Conley Mine, the northeastern strike extension of the Henderson zone, was discovered in 1911 and the 2 properties were combined in 1937 as Canada Talc Limited. As part of the rehabilitation of the mine site following mine closure, all mine buildings have been removed, shafts capped, waste piles levelled, pit walls contoured, and revegetation of the site has been completed.

The discovery of nephrite jade at Madoc is similar to that of a recent discovery at Alpe Mastabia in northern Italy. In 1995, while examining the waste material outside an abandoned talc mine, P. Nana, a local mineral collector and jewelry shop owner, noticed an attractive green stone. Recognizing the potential gemological value, he consigned rough samples to lapidary workshops in China and Germany and the material was identified as gem-quality nephrite jade. The origin of the talc deposit, as well as of

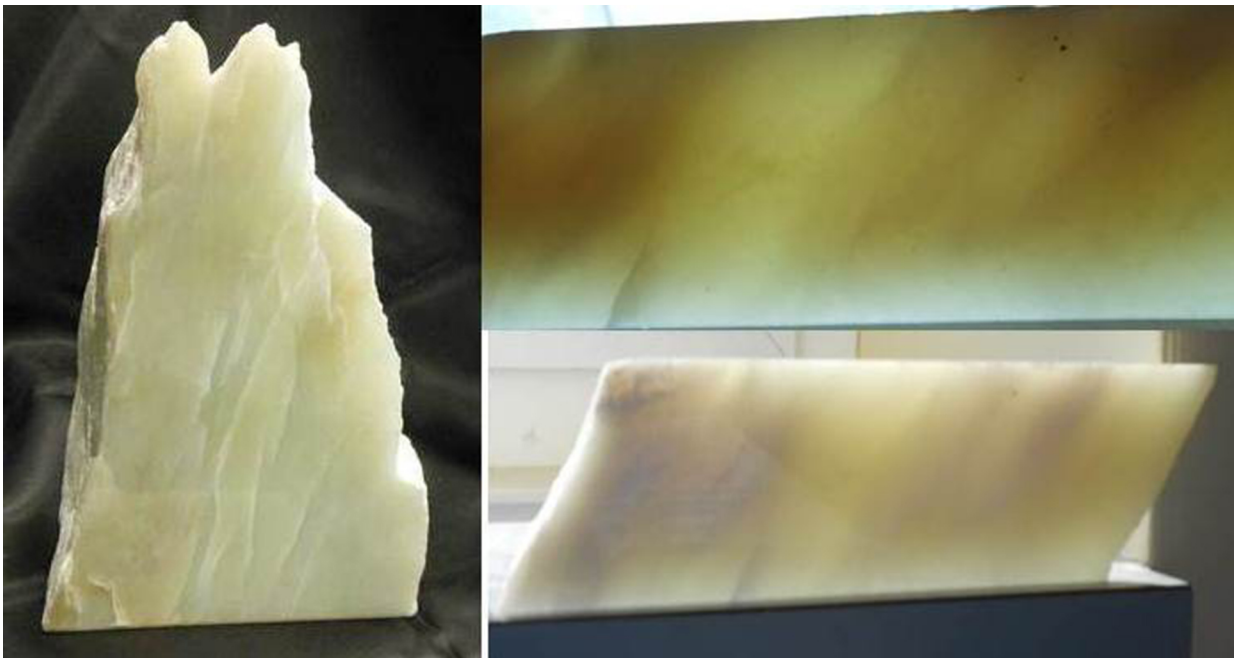

Photo 4. Left) Polished piece of sample Cantal-14-1, nephrite jade, approximately 15 by 9 cm, from Canada Talc mine waste rock pile, Madoc, Ontario. **Lower right)** Polished diamond-drill core of pale green nephrite and white calcitic marble; 4.6 cm high, from Canada Talc mine dumped core pile. **Upper right)** Same sample as shown in lower right, showing translucence of nephrite in back lighting; sample thickness at centre is 2.0 cm.

Photo 5. Nephrite jade pendants made from pieces of sample Cantal-14-1: overhead lighting (**upper left** and **lower centre**) and backlighting (**upper right**), showing translucence and pale green colour. Pendants are approximately 4.0 by 1.5 cm (upper left and right) and 2 cm wide (lower centre).

tremolite and nephrite, is ascribed to metasomatic processes within dolomitic marbles during Alpine metamorphism. During the years of operation at the Alpe Mastabia talc mine, from 1964 to 1994, nephrite boulders associated with the talc were discarded as waste. The production and marketing of nephrite jade from Alpe Mastabia began in the early 2000s and production continues due to the high quality of finished jewelry pieces and other ornamental objects (Adamo and Bocchio 2013). Examples of jewelry produced from the Madoc nephrite are shown in Photo 5.

DEFINITION OF JADE

There are 2 forms of jade, nephrite and jadeite, consisting of distinct minerals. Nephrite consists of massive, micro- to cryptocrystalline intergrowth of grains of the tremolite–actinolite series of the amphibole group, $Ca_2(Mg,Fe)_5(OH)_2[Si_8O_{22}]$; jadeite is a clinopyroxene with composition $Na_2(Al,Fe)_2[Si_4O_{12}]$. Although jadeite can be slightly harder than nephrite (Moh's scale hardness of 7.0 and 6.5, respectively), nephrite is the tougher variety as a result of an interlocking felted mass of fibrous tremolite-actinolite crystals. Jadeite is an aggregate of interlocking monoclinic crystals that are more granular than fibrous. Nephrite jade can range in colour from nearly white when composed of magnesium-rich tremolite, to dark green or nearly black when iron-rich actinolite is the predominant component. The white variety, commonly known as "mutton-fat" is more highly valued than the darker green "spinach jade". Some inconsistency of colour and spottiness, as a result of impurities such as calcite, diopside, garnet, magnetite, pyrite, graphite, talc and serpentine, are acceptable in the lapidary and jade art industries (Harlow, Sorensen and Sisson 2007).

GEOLOGICAL SETTING

Nephrite jade can be produced by 1) the metamorphism of dolomite and silica to form tremolite or 2) the alteration of serpentinite by calcium metasomatism at contacts with more silicic rock (Harlow, Sorensen and Sisson 2007). The southeastern Ontario occurrence is of the dolomitic nephrite model.

Talc is the first mineral to form during progressive metamorphism of siliceous dolomitic limestone, according to the reaction: 3 dolomite + 4 quartz + 1 H_2O = 1 talc + 3 calcite + 3 CO_2 (Winkler 1979). With increasing temperature, tremolite is formed from the talc–calcite assemblage, followed by diopside-tremolite-quartz at higher grade metamorphism. Harlow, Sorensen and Sisson (2007) suggest that the most favourable conditions for dolomite-derived nephrite are in areas of upper greenschist-facies to lower amphibolite-facies (<550°C and 100 to 200 MPa) metamorphism in which faults and fissures have channeled post-magmatic fluids from igneous intrusions through dolomite and provide conduits for the dispersion of CO_2, required for completion of the reaction. Zones of nearly monomineralic nephrite can be explained by high fluid to rock ratios, which could remove excess carbonate.

In southeastern Ontario, an area of upper greenschist-facies metamorphism, formerly known as the "Hastings Metamorphic Low", extends from eastern Belmont Township through Marmora, Madoc and Elzevir townships and north into the southern parts of Lake and Tudor townships (Easton 1992). Within this area are large areas of carbonate metasedimentary rocks intruded by granitic, syenitic and gabbroic rocks (Figure 9).

The Canada Talc deposit occurs within marble of the Belmont domain, an area of middle to upper greenschist-facies metamorphism in which quartz and dolomite coexist in carbonate rocks, except in zones of higher metamorphic grade within thermal aureoles of intrusive bodies. The deposit occurs in a zone of tremolitic marble approximately 800 m northwest of the Moira granite (*see* Figure 9). The lithological sequence through the Canada Talc orebody, from southeast to northwest, is 1) dark grey to black phyllite; 2) micaceous, tremolitic dolomite; 3) steatized dolomite; 4) high-grade talc ore; 5) laminated tremolitic dolomite (possibly altered stromatolitic dolomite); 6) siliceous, stromatolitic dolomite; 7) mottled grey-white dolomite; and 8) an undifferentiated thick dolomite sequence (Simandl and Ogden 1982). The presence of laminated tremolitic dolomite adjacent to stromatolitic dolomite, consisting of coexisting quartz and dolomite laminae, suggests that these units represent the outer limit of

the thermal metamorphic aureole of the Moira granite. The talc zone, therefore, has formed within siliceous dolomitic host rock close to the boundary between low- and medium-grade metamorphic conditions at the margin of the thermal aureole of the Moira granite, by prograde metamorphism to tremolite followed by retrograde metamorphism to talc as suggested by Hewitt (1972).

Previous explanations of the origin of the talc zone (Wilson 1926; Spence 1940; Hewitt 1972) involve siliceous hydrothermal fluids originating from the Moira granite intrusion being introduced into the dolomite sequence along structural channels, which is also the model of dolomite-derived nephrite favoured by Harlow, Sorensen and Sisson (2007). However, although structural control was involved in the circulation of fluids, it is not necessary to assume an external source of silica. The presence of thin quartzite beds and stromatolitic marble, consisting of alternating quartz and dolomite laminae in the host rock sequence, is evidence of a pre-metamorphism environment with the ingredients necessary for the formation of talc and tremolite. The contribution of the Moira granite to the formation of the talc deposit may have been primarily heat; in which case, talc and tremolite alteration zones may be expected near the margin of the thermal aureole of any igneous intrusions, whether mafic or felsic, in areas of siliceous dolomitic marble of low regional metamorphic grade and with structures present that allow circulation of magmatic or meteoric fluids and escape of CO_2. The discovery of nephrite jade in waste rock from the Canada Talc Mine indicates that there may be zones in which the dolomite and quartz content were such that the metamorphic reaction to tremolite was complete, excess carbonate may have been removed by a large fluid to rock ratio, and in which there was little to no retrograde metamorphism to talc.

The marbles of the Madoc–Marmora area also contain green marble deposits that have been quarried as decorative stone since the 1930s. One of these, currently operated by Upper Canada Stone Company Ltd. in Huntingdon Township, approximately 9 km west of the Canada Talc Mine, was described by Hewitt (1964, p.50) as “a remarkably strong and hard marble” consisting of calcite, chlorite and serpentine grains

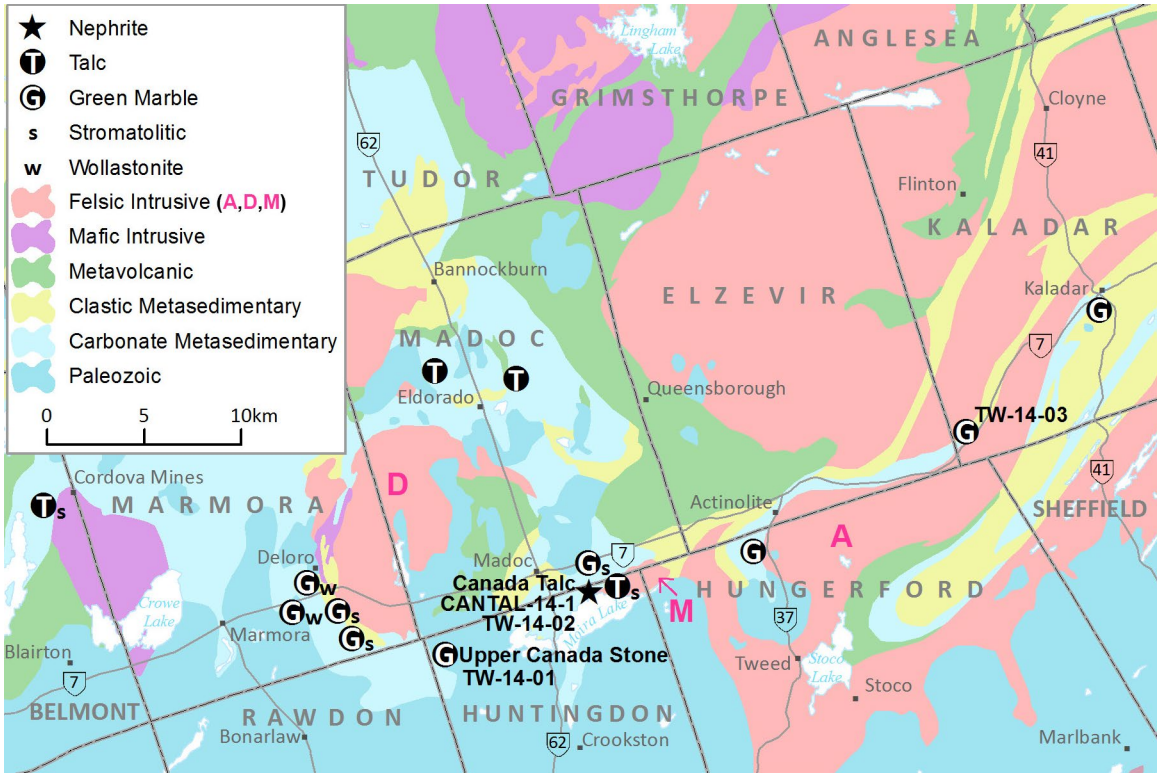

Figure 9. Geology of the Belmont–Kaladar area, showing locations of the Canada Talc Mine nephrite occurrence, and occurrences of green marble and marble-hosted talc. Felsic plutons mentioned or discussed in text: A, Addington granite; D, Deloro granite; M, Moira granite. Geology *from* Ontario Geological Survey (2011).

with “serrate irregular borders which contribute to high strength”. Petrographic thin section examination by Wilson (2014) of samples of green marble from the Huntingdon quarry (Photo 6: sample TW-14-01) and from a rock cut on Highway 7 near the Elzevir–Kaladar township line (sample TW-14-03) indicated tremolite content of 88% and 94%, respectively, giving a more accurate explanation for the strength and hardness of the green marble and indicating the potential for the discovery of nephrite jade zones. An abandoned green marble quarry, south of the village of Kaladar (*see* Figure 9), lies outside the area of greenschist-facies metamorphism and derives its colour from high diopside content rather than high tremolite-actinolite content.

Several samples were submitted for petrographic (thin section) analysis:

Sample	Source	Site Location	Petrographic Description (Wilson 2014)
Cantal-14-1	Waste pile	Canada Talc Mine site, Madoc	100% pale greenish-white tremolite; foliated, fine-grained, remarkably pure, near-white nephrite jade
TW-14-01	Stockpile of broken rock	Upper Canada Stone green marble quarry, Huntingdon Township (UTM 297210E 4928155N)	88% pale greenish-white tremolite; 10% carbonate, 2% combined diopside + leucoxene, trace pyrite + chalcopyrite; fine-grained, massive, tremolite-rich rock (*see* Photo 6)
TW-14-02	Waste rock pile	Canada Talc Mine site, Madoc	70% pale greenish white tremolite, 24% carbonate, 5% muscovite, 1% pyrite, trace pyrrhotite + chalcopyrite; banded calcite-tremolite schist
TW-14-03	Road cut	north side of Highway 7, ~30 m east of the boundary between Elzevir and Kaladar townships (UTM 324520E 4937870N)	94% tremolite, 6% muscovite, trace leucoxene + pyrite; banded tremolite schist with fine-grained, greenish-white layers and coarser pale brownish layers

Green marble also occurs adjacent to wollastonite-bearing marble zones at the Platinova–Cominco property and Deloro West zone property along the western margin of the Deloro granite in Marmora Township (MacKinnon 1990). The proximity of the 2 alteration assemblages may be the result of a thermal metamorphic gradient from the higher temperature (wollastonite) to lower temperature (tremolite) zones associated with the intrusion.

Photo 6. Green, tremolitic marble (sample TW-14-01) collected from the Upper Canada Stone Company Ltd. quarry, Huntingdon Township; white mottling is calcitic marble, sample width 16 cm.

POTENTIAL FOR NEPHRITE JADE IN SOUTHEASTERN ONTARIO

Although the presence of nephrite jade has been confirmed in the Madoc area, very little follow-up work has been done. Two zones of green marble, with tremolite content of 85 to 95%, occur within a belt of marble containing quartz and dolomite (locally stromatolitic), extending from the northern margin of the Addington granite, westward along the north side of the Moira granite, and continuing along the south and west margins of the Deloro granite (*see* Figure 9). Several additional occurrences of green marble within the belt indicate favourable conditions for alteration of quartz-dolomite to tremolite-actinolite and the potential for additional nephrite jade mineralization. Marble-hosted occurrences of talc and wollastonite associated with thermal metamorphic aureoles of intrusive bodies should also be considered as target areas for nephrite, with the potential for tremolite occurrence in adjacent higher and lower temperature metamorphic zones, respectively.

Future work by staff of the Southern Ontario Regional Resident Geologist's Office will include acquisition and examination of diamond-drill core from the Canada Talc Mine; examination of diamond-drill core from the Platinova–Cominco wollastonite prospects, Marmora Township, stored at the Tweed Drill Core Library; field work in the vicinity of known occurrences of green marble and talc; and field studies along the favourable marble belt in the vicinity of igneous intrusive rocks.

Trap Rock: Aggregate and Industrial Use in Southern Ontario

Trap rock is any dark, fine-grained, non-granitic intrusive or extrusive igneous rock, including basalt, peridotite, diabase and gabbro. Trap rock has been quarried in southeastern Ontario for over 100 years, originally for use as construction aggregate and roofing material (mixed with pitch) and, more recently, for top-coat asphalt, roofing shingles, railway ballast, filter stone and rock wool production.

Ontario's consumption of aggregates is projected to average approximately 186 million tonnes per year over the next 20 years, 13% higher than in the past 20 years. Although crushed stone currently accounts for less than half of the primary aggregate consumed, demand is expected to continue to increase over the next 20 years as new construction standards specify higher quality stone (Altus Group Economic Consulting 2010). For example, on highways with speeds in excess of 80 km per hour, the specifications require the use of premium surface-course mixes to provide adequate frictional resistance and to resist rutting. These require 100% premium coarse and fine aggregates, such as crushed trap rock.

The mineral wool market is projected to grow by 7.0% per year to 2019, with increasing demand for mineral wool–based thermal and acoustic insulation in the residential and commercial buildings and demand for heat insulation for the industrial applications (Markets and Markets 2015). The primary ingredient in mineral wool is trap rock, generally basalt, diabase or gabbro, which is blended with other materials, such as anorthosite, limestone, dolostone and slag. In some cases, higher magnesium content of the trap rock may eliminate the need for some of the additional ingredients. A high magnesium gabbro quarried in Elzevir Township, southern Ontario, has been successfully tested in the production of rock wool and the quarry (Danford Granite Ltd., Bridgewater Quarry) is expected to begin full production in 2016 (A. Danford, Danford Granite Ltd., personal communication, 2015). Other uses of mineral wool are resin-bonded panels; as filler in compounds for gaskets, brake pads and plastics in the automotive industry; as an additive to asphalt; as a filtering medium, and as a growth medium in hydroponics.

Continuous basalt fiber is also produced by melting trap rock, but, unlike mineral wool, the extruded material forms continuous strands that can be woven or compressed into various products, such as cloth, reinforcing mesh, chopped fiber and reinforcing bars. About 80% of the total basalt fiber demand in 2014 was from building construction, automobile and wind energy industries, generally in applications

requiring high-temperature resistance, chemical resistance, durability, mechanical strength and low water absorption. The global basalt fiber market has experienced significant growth in the past few years and is expected to continue to grow at 13.1% annually between 2015 and 2020 (Research and Markets 2015).

The current trap rock producers in southern Ontario are shown on Figure 10:

- MRT Aggregates Inc. quarries gabbro for use as highway construction aggregate and railway ballast
- IKO Industries Ltd. produces granules for production of roofing shingles from andesitic rock
- Drain Bros. Excavating Ltd. quarries basalt for use as roofing granules, highway construction aggregate, railway ballast and rock wool production
- Danford Granite Ltd. quarries both a high-iron gabbro for road aggregate and railway ballast, and high-magnesium gabbro for rock wool production

Mafic metavolcanic rocks are concentrated in the south-central part of the Central Metasedimentary Belt, between Peterborough and Kaladar. Mafic intrusive rocks are found throughout the Central Metasedimentary Belt. The extensive road network, as well as access to rail lines and deep-water ports, makes southern Ontario attractive for additional trap rock extraction.

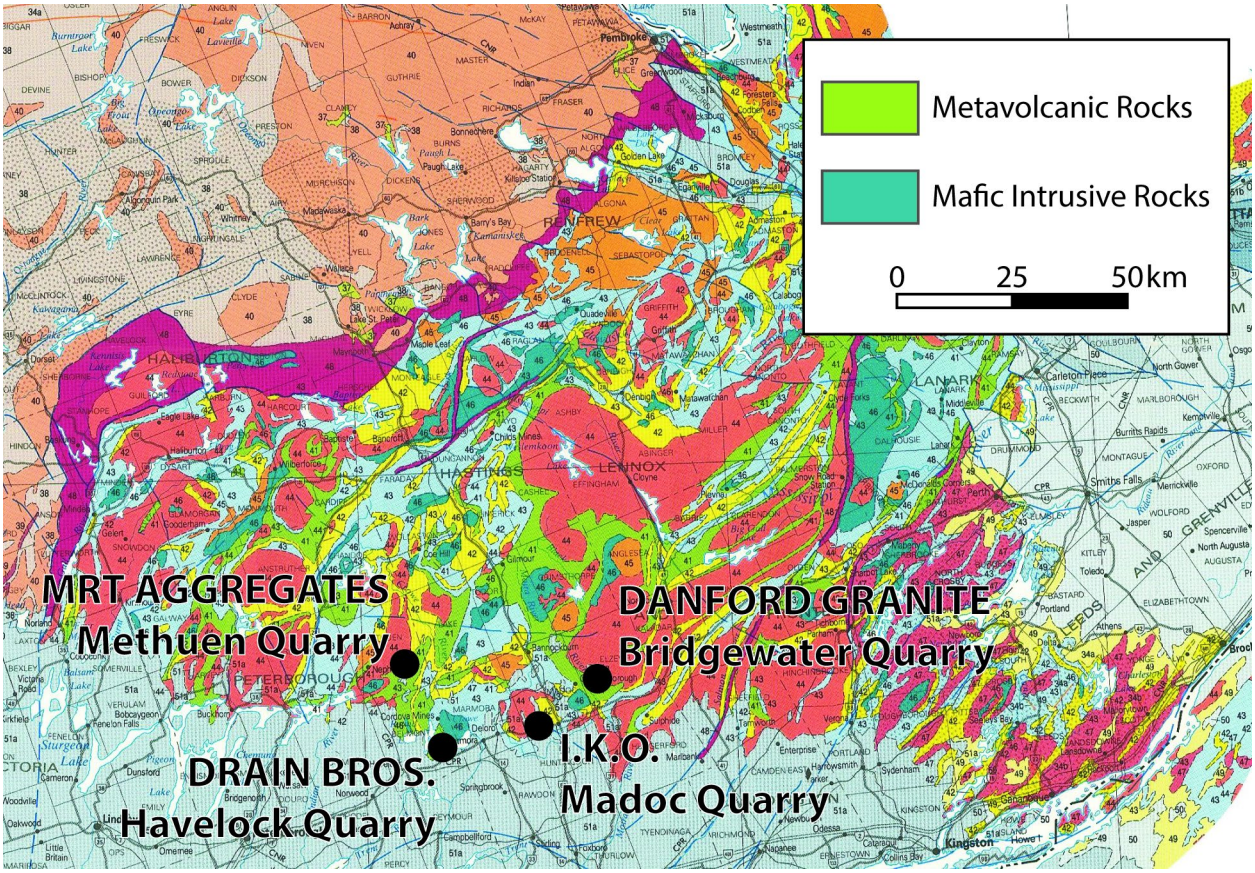

Figure 10. Locations of southern Ontario trap rock quarries (geology *from* Ontario Geological Survey 1991).

Tables 8 through 16 list currently inactive mineral deposits with identified resources and past-producing mineral occurrences.

Table 8. Historic production of copper, lead, zinc – Southeastern Ontario District.

Mine	Township	Operating	Tons Milled	Production
Kingdon	Fitzroy	1884–1885, 1914–1931	905 000	76 821409 pounds Pb concentrate; 857 312 pounds Zn concentrate; 60 074 072 pounds Pb recovered
Long Lake	Olden	1897–1925, 1973–1974	3442, not available	$41 550 ore value, 9467 tons Zn valued at $1 227 000
Eldorado Copper	Madoc	1906	not available	234 000 pounds Cu matte containing 230 ounces Au, 182 ounces Ag, 109 000 pounds Cu
Hollandia Lead	Madoc	1903–1906	not available	2 653 365 pounds Pb

Table 9. Historic production of iron – Southeastern Ontario District.

Mine	Township	Operating Years	Tons Milled	Grade (% Fe)
Calabogie	Bagot	1883–1901	10 000	26
Martel	Bagot	pre-1890	2000	58.71
Williams (Black Bay)	Bagot	1880–1890	25 000	51.89
Black Lake	Bedford	1882–1884	4000	40
Glendower	Bedford	1873–1895	50 000	50 – 60
Belmont (Ledyard)	Belmont	1899–1900, 1911–1913	8433	51.2
Blairton	Belmont	1820–1875	300 000	51.8
Playfair (Dalhousie)	Dalhousie	1866–1871	11 100	57.6
Radnor	Grattan	1901–1907	18 824	47.5
Eagle Lake (Blessington)	Hinchinbrooke	1887–1891	700	65.55
Tomahawk (Mag-Iron)	Lake	1947, 1950–1957	2096	50.9
Wilbur	Lavant	pre-1900, 1907–1908	146 892	56.69
Magnetawan	Lount	1910–1912	6000	59.55
Paxton	Lutterworth	pre-1910	1000	not available
Miller	Madoc	1899	6823	not available
Wallbridge	Madoc	1900–1901, 1919, 1921	3421	not available
Marmoraton	Marmora	1952–1978	28 000 000	40
Bessemer	Mayo	1902–1913	99 613	42.18
Childs	Mayo	1913	9649	38.7
McNab	McNab	1873–1874	15 000	68
Robertsville and Mary	Palmerston	1895, 1900–1901, 1918–1909	13 477	70.5
Fournier	S. Sherbrooke	1873	600	60
Howland	Snowdon	1880–1882	1500	58
Victoria	Snowdon	1882	unknown	58.35
Dog Lake	Storrington	1899	600	51.12
St. Charles	Tudor	1900–1902	5186	57 – 60
Coe Hill	Wollaston	1884–1914	100 000	51.4
		Total	**28 841 914**	

Table 10. Historic production of gold – Southeastern Ontario District.

Mine	Township	Operating Years	Tons Milled	Ounces Produced	Grade (ounces/ton)
Big Dipper	Barrie	1907–1909	52	17	0.33
Cook	Marmora	1901–1904	1483	289	0.26
Cordova	Belmont	1892	120 670	22 774	0.19
Craig	Tudor	1905–1906	1850	248	0.13
Deloro	Marmora	1897–1902	39 143	10 360	0.26
Gatling 5 Acre	Marmora	1900–1903	6114	2353	0.38
Gilmour	Grimsthorpe	1909–1910	550	172	0.31
Golden Fleece	Kaladar	1919–1922	unknown	480	unknown
Ledyard	Belmont	1893–1994	55	13	0.24
Pearce	Marmora	1893–1908	239	302	1.26
Richardson	Madoc	1866–1868	unknown	75 – 100	0.408
Sophia	Madoc	1896–1901	1800	110	0.06
Sovereign	Marmora	1878 1892–1900	unknown 1962	970 370	unknown 0.19
Star of the East	Barrie	1905–1907	976	134	0.14
		Total	**174 894**	**38 592**	

Table 11. Historic production of fluorite – Southeastern Ontario District.

Mine	MDI Number	Township	Operating Years	Total Production (Tons)
Bailey	31C06NW00003	Madoc	1907, 1916, 1917, 1944–1950	25 000
Blakely	31C06NW00019	Huntingdon	1918–1920, 1928, 1941–1947	5026
Coe	31C06NW00008	Huntingdon	1941–1942	114
Dwyer	31E01SE00091	Cardiff	1918–1920, 1943, 1944	97
Herrington South	31C05NE00009	Huntingdon	1917	13
Howard, Fred Hill	31C06NW00014	Huntingdon	1918, 1920, 1929, 1940–1942, 1944	2500
Johnston	31C06NW00013	Huntingdon	1943, 1944–1947, 1949	187
Keene	31C06NW00004	Huntingdon	1918–1919, 1943, 1944, 1950	5000
Kilpatrick	31C06NW00005	Huntingdon	1944, 1953–1959	11 566
Lee Junior	31C05NE00008	Madoc	1917, 1940, 1943–1945	2000
Lee Senior	31C05NE00006	Madoc	1916–1918, 1942, 1943	1600
McIlroy	31C05NE00003	Madoc	1917–1918, 1923, 1944	540
Miller	31C05NE00005	Madoc	1917–1919	460
Noyes	31C06NW00011	Huntingdon	1917–1920, 1941–1943	25 000
Palmateer	31C06NW00016	Huntingdon	1942	44
Perry	31C06NW00009	Huntingdon	1915–1920, 1941–1943	8000
Perry Lake	31C06NW00007	Huntingdon	1910, 1913, 1915, 1917, 1952, 1960	4000
Ponton	31C05NE00004	Madoc	1929–1942	1500
Rogers	31C06NW00018	Huntingdon	1909–1914, 1943–1951	45 000
Rooks	31C12SE00003	Madoc	1916–1918	100
South Reynolds	31C06NW00010	Huntingdon	1917–1918, 1943	100
Wallbridge and Herrington	31C05NE00007	Madoc	1920–1922, 1941–1943	6600
William Reynolds	31C12SE00002	Madoc	1941–1942	88

Fluorspar, a commercial fluorite product, is used as a flux in the making of steel and ceramics, as a constituent in the electrolytic process of making aluminum and in the production of hydrofluoric acid (HF). During World War II, a Canadian Government assistance program in the form of loans and drill hole explorations stimulated development of the Madoc deposits (Guillet 1964, p.1).

Table 12. Past-producing magnetite mines – Southeastern Ontario District.

Deposit / Township	Mineral Deposit Inventory Number / Status	Description	Reference
Belmont (Ledyard) Belmont Tp.	MDI31C12SW00004 (Past Prod. w Reserves)	Drilling from 1906 indicated 200 000 tons of concentrating ore	MRC 11, p.287
Bessemer Mayo Tp.	MDI31F04SE00012 (Past Prod. w Reserves)	Reserves estimated at 2 480 819 tons averaging 28.62% recoverable Fe from 4 deposits	MRC 11, p.167
Black Lake Bedford Tp.	MDI31C10SE00026 (Past Prod. w/o Reserves)	Disseminations and massive magnetite in exposed widths from 10 to 50 feet	MRC 11, p.134
Blairton Belmont Tp.	MDI31C05NW00026 (Past Prod. w Reserves)	1914 reserves calculated at 1 800 000 tons of 51.8% Fe and 0.5 million tons of 54.9% Fe	MRC 11, p.288
Bluff Point Bagot Tp.	MDI31F07SE00011 (Past Prod. w/o Reserves)	Two main magnetite-bearing zones, each about 500 feet long and 40 feet wide	MRC 11, p.313
Calabogie Bagot Tp.	MDI31F07SE00009 (Past Prod. w Reserves)	The deposit contains 27 200 000 tons of ore grading 22.28% Fe proven by diamond drilling, recoverable by open pit	MDC 20, p.67
Chaffey South Crosby Tp.	MDI31C09NW00011 (Past Prod. w Reserves)	Reserves estimated to a depth of 500 feet are 11 110 000 gross tons averaging 29.76% Fe	MRC 11, p.258
Childs Mayo Tp.	MDI31F04SE00013 (Past Prod. w Reserves)	Reserves estimated at 6 193 330 tons averaging 19.25% recoverable Fe	MRC 11, p.169
Coe Hill Wollaston Tp.	MDI31C13SW00010 (Past Prod. w Reserves)	Reserves estimated in 1914 at 600 000 tons averaging 51.4% Fe	MRC 11, p.177-178
Glendower Bedford Tp.	MDI31C10SE00022 (Past Prod. w/o Reserves)	Early drilling indicated massive and disseminated ore at a depth of 500 feet	MRC 11, p.135
Grattan (Radnor) Grattan Tp.	MDI31F06NE00017 (Past Prod. w Reserves)	Proven reserves of 3 639 600 tons to a vein depth of 363 feet and indicated reserves of 9 099 000 tons to a vertical depth of 600 feet, averaging 27.74% Fe	MDC 20, p.98
Howland Snowdon Tp.	MDI31D15SE00096 (Past Prod. w/o Reserves)	Magnetite in a zone 25 feet in diameter at surface and larger with depth	MRC 11, p.149
Marmoraton Marmora Tp.	MDI31C05NE-00014 (Past Prod. w Reserves)	27 966 762 tons of ore averaging 42.8% Fe produced	OFR 5515, p.322
Martel Bagot Tp.	MDI31F07SE00013 (Past Prod. w/o Reserves)	Magnetite body 20 feet thick, dipping 60° southeast	MRC 11, p.317
Matthews North Crosby Tp.	MDI31C09NW00009 (Past Prod. w Reserves)	Estimated reserves to depth of 400 to 500 feet are 33 727 000 gross tons averaging 25.08% Fe, which includes 11 861 000 gross tons averaging 31.36% Fe	MRC 11, p.257
Radenhurst and Caldwell Lavant Tp.	MDI31F02NE00012 (Past Prod. w Reserves)	Main zone with indicated tonnage of 6500 tons of ore per slope foot averaging 32.77% Fe. Three additional zones totalling 1600 feet in length, averaging 17.08%, 16.71% and 25.50% Fe	MRC 11, p.251
Rankin Mayo Tp.	MDI31F04SE00016 (Past Prod. w Reserves)	Reserves estimated at 15 691 599 tons containing 15.3% recoverable Fe	MRC 11, p.170
Robertsville Palmerston Tp.	MDI31C15NE00005 (Past Prod. w/o Reserves)	Two zones, Robertsville Mine is 700 feet long and 50 feet wide and the Mary Mine 900 feet to northwest	MRC 11, p.141
St. Charles Tudor Tp.	MDI31C13SE00014 (Past Prod. w/o Reserves)	Three main deposits within an area of approximately 13 500 square feet	MRC 11, p.176
Summit Lake (Tomclid) South Canonto Tp.	MDI31F02SW00032 (Past Prod. w Reserves)	Published reserves in 1993 estimated at 3 Mt averaging 40% Fe; reserve estimate has not been adjusted to reflect production from the deposit in late 1990s	MP 161, p.377
Tomahawk Lake Tp.	MDI31C12NW00002 (Past Prod. w Reserves)	Lenses and patches of magnetite occur over a strike length of approximately 1000 feet	MRC 11, p.155
Victoria Snowdon Tp.	MDI31D15SE00098 (Past Prod. w/o Reserves)	Deposit was worked from a trench 240 feet long and 16 feet wide	MRC 11, p.150
Wilbur Lavant Tp.	MDI31F02SE00009 (Past Prod. w/o Reserves)	Nine workings reported	MRC 11, p.252
Williams Bagot Tp.	MDI31F07SW00027 (Past Prod. w/o Reserves)	Two zones of magnetite, approximately 800 and 240 feet long, 20 feet wide	MRC 11, p.318
Yuill Darling Tp.	MDI31F02NE00009 (Past Prod. w/o Reserves)	Lens of high-grade magnetite, 30 m long and 9 m wide, mined to a depth of 21 m	MDC 20, p.92

Note: *The resource estimates listed in this table are historic figures and do not follow the required disclosure for reserves and resources as outlined in National Instrument 43-101.*

Table 13. Uranium deposits not currently being mined in the Southeastern Ontario District in 2015.

Deposit Township	MDI Number	Commodity	Reserve	Reserve Reference
Zenmac Burleigh, Anstruther Tps.	MDI31D09NE-00033 (Developed Prospect w Reserves)	U, Th	Indicated and inferred reserves are estimated at 406 000 tons grading 1.77 pounds U_3O_8 per ton	OFR 5311, p.461
Pole Star Burleigh, Anstruther Tps.	MDI31D09NE-00042 (Prospect)	U	Estimated size and grade from diamond drilling is 370 000 tonnes averaging 0.8 kg U_3O_8 or double using a lower grade of 0.6 kg/tonne	OFR 5635, p.199-200
Canadian Dyno Cardiff Tp.	MDI31D16NE-00032 (Past Prod. w Reserves)	U, Th	Reserves of possible ore were estimated at 500 000 tons grading 0.065% U_3O_8	OFR 5311, p.71-72
Bicroft (Centre Lake) Cardiff Tp.	MDI31D16NE-00043 (Past Prod. w Reserves)	U, Th	Estimated reserves above 1200 foot level: 559 000 tons grading 2.0 pounds U_3O_8 per ton before dilution (1960)	OFR 5311, p.66-67
Blue Rock Occurrence Monmouth Tp.	MDI31D16NE-00143 (Developed Prospect w Reserves)	U, REE	Reserves estimated at 292 444 tons at 0.095% U_3O_8 within 500 feet of shaft & to a depth of 600 feet; 56 720 tons at 0.120% U_3O_8 to a depth of 200 feet in the Lake zone	OFR 5311, p.132, 133
Empire B Zone Monmouth Tp.	MDI31D16NE-00146 (Developed Prospect w Reserves)	U, Th, F	Drilling has indicated reserves of 2 179 166 tons grading 0.726 pounds U_3O_8 per ton	OFR 5311, p.135
Kenmac Chibougamau Cardiff Tp.	MDI31D16NE-00165 (Prospect)	U, Th	Estimated reserves: 200 000 tons averaging 0.20% U_3O_8 (1955)	OFR 5311, p.101
Rare Earth #1 Monmouth Tp.	MDI31D16NW-00195 (Developed Prospect w Reserves)	REE, U, Th	Official estimated reserves 541 821 tons indicated averaging 0.116% U_3O_8 (1957)	MRC 4, p.26
Farcroft Anstruther Tp.	MDI31D16SE-00059 (Developed Prospect w/o Reserves)	U	not known	
Garland Anstruther Tp.	MDI31D16SW-00093 (Prospect)	U, Th	not known	
Cavendish Cavendish Tp.	MDI31D16SW-00099 (Prospect)	U, Th	Estimated reserves: 435 624 tons grading 0.096% U_3O_8 (chemical)	OFR 5311, p.476
Bicroft (Croft) Cardiff Tp.	MDI31E01SE-00224 (Prospect)	U	Estimated reserves in 3 zones: 979 810 tons grading 1.20 pounds U_3O_8 per ton	OFR 5311, p.84-85
Fission Cardiff Tp.	MDI31E01SE-00235 (Prospect)	U, Th, F	not known	
Baumhour–Campbell Faraday Tp.	MDI31E01SE0-0248 (Prospect)	U, Th	not known	
Mell–Quirke Monteagle Tp.	MDI31F04NE-00067 (Prospect)	U, Th	not known	
Greyhawk Mine Faraday Tp.	MDI31F04SW-00036 (Past Prod. w Reserves)	U, Th	Estimated reserves of 0.2 million tons grading 0.065% U_3O_8	MDC 23, p.62
Faraday/Madawaska Mine Faraday Tp.	MDI31F04SW-00037 (Past Prod. w Reserves)	U, Th	Proven and probable reserves of 1 023 086 tons at 0.145% U_3O_8 (1976)	MDC 23, p.60

Note: *The resource estimates listed in this table are historic figures and do not follow the required disclosure for reserves and resources as outlined in National Instrument 43-101.*

Table 14. Mineral deposits not currently being mined in the Southeastern Ontario District in 2015. (Note: table does not include nepheline syenite, trap rock, REE and dimension-stone deposits.)

Abbreviations

AF ..... Assessment Files
AR ..... Annual Report
CAMH ..... *Canadian and American Mines Handbook*
CMH ..... *Canadian Mines Handbook*
GR ..... Geological Report
MDC ..... Mineral Deposit Circular [No.15–]
[*formerly* Mineral Resources Circular, No.1-14]
MDI ..... Mineral Deposit Inventory
MLS ..... Mining Lands, Sudbury
MP ..... Miscellaneous Paper
NM ..... *The Northern Miner*
OFR ..... Open File Report
PC ..... Personal Communication
Status: A; E; I; M ..... Active; Exploration; Inactive, Mining

Deposit Township	MDI File Number	Status	Commodity	Reserves	Reserve Reference
Ore Chimney prospect Barrie Township	MDI31C14SE-00142 (SO 1130)	AE	Ag, Au, Zn, Pb	11 000 tons above the 500-foot level Averages: 0.2 oz per ton Au, 5.64 oz per ton Ag, 2.0% Zn, 1.0% Pb	MDC 12, p.132; MDC 18, p.33
Macassa Nickel Limerick Township	MDI31C13SE-00099 (SO 0595)	AE	Ni, Cu	2 000 000 tons @ 1.0% Ni, 0.25% Cu	MDC 12, p.138
Renfrew Zinc (Renprior) Admaston Township	MDI31F07NE-00063 (SO 0286)	AE	Zn	16 000 tons @ 10.5% Zn to a depth of 30 m; Breakwater Resources optioned the property to Noranda Mining and Exploration in 1996	MDC 12, p.226; MDC 20, p.17
Harvey Simon prospect Lyndoch Township	MDI31F03NW-00044 (SO 0259)	AE	Cu, Fe, Zn	250 000 tons @ 1.1% Cu to 350 feet	MDC 12, p.226; MDC 20, p.45
Clyde Forks deposit Lavant Township	MDI31F02SE-00064 (SO 0351)	I	Cu, Sb, Ag, Hg	60 000 tons @ 0.67% Cu, 0.37% Sb, 0.03% Hg, 1.32 oz per ton Ag	MDC 20, p.36
Twin Lakes Diorite Methuen Township	MDI31C12NW-00114 (SO 3840)	AE	Ti	13.2 Mt of 21.7% TiO_2, recoverable from open pit to a depth of 165 m, with rock:ore ratio = 0:54. Diorite wall rock is currently being mined by MRT Aggregates for trap rock	Kingston, MacKinnon and Caley (1990, p.99)
Grattan deposit Grattan Township	MDI31F06NE-00017 (SO 0270)	AE	Fe	Proven: 3 639 600 tons to a vein depth of 363 feet. Indicated: 9 099 000 tons to a vertical depth of 600 feet @ average grade of 27.74% Fe	MDC 20, p.98
Radenhurst–Caldwell deposit Lavant Township	MDI31F02NE-00012 (SO 0349)	I	Fe	Main lens 2000 feet long by 31.3 feet wide; contains 6500 tons per slope foot at a grade of 32.77% Fe; 3 additional zones totalling 1600 feet in length average 17%, 16.7% and 25.5% Fe	MDC 20, p104
Bessemer deposit Mayo Township	MDI31F04SE-00012 (SO 0235)	AE	Fe	No.4 deposit 2 480 819 tons @ 28.62% recoverable Fe. In 2007–2008, deposit was evaluated as source of iron	MDC 20, p.110
Childs deposit Mayo Township	MDI31F04SE-00013 (SO 0236)	AE	Fe	6 193 330 tons @ 19.25% recoverable Fe. In 2007–2008, deposit was evaluated as source of iron	MDC 20, p.114
Calabogie Magnetite property / Algoma Ore Prop. Ltd. Bagot Township	MDI31F07SE-00009 (SO 0353)	AE	Fe	Reserves of 45 million tons @ 25% Fe to 500 feet and 28% Fe to 1000 feet	MDC 11, p.314
Buckhorn deposit Bagot Township	MDI31F07NE-00069 (SO0362)	I	Mo	Largest of numerous small lenses contains 1500 tons @ 1% MoS_2	MDC 20, p.132
Bannockburn (Madoc Mining Company Ltd.) Madoc Township	MDI31C12NE-00195 (SO 7274)	A	Au	225 000 tons grading 0.267 ounce per ton Au	MP 161, p.377
Cooper Spruce Ridge Resources Ltd. Elzevir Township	MDI31C11SW-00044 (SO 2679)	I	Au, talc	3 Mt @ 30–33% recoverable talc and 40 000 t @ 8.0 g/t Au	OFR 5945, p.92; OFR 5808, p.79
Dingman deposit Marmora Township	MDI31C12SE-00040 (SO 3590)	AE	Au	11.6 Mt @ 0.97 g/t Au	OFR 6296, p.50-51

Deposit Township	MDI File Number	Status	Commodity	Reserves	Reserve Reference
Hawley Ram Petroleum Limited Olden Township	MDI31C10NW-00117 (SO 4057)	I	Wollastonite	2.5 Mt @ 32% wollastonite to a vertical depth of 75 m	OFR 5943, p.337
Marmora Gitennes Exploration Inc. Marmora Township	MDI31C12SE-00096 (SO 3729)	I	Wollastonite	450 000 t (open pit) @ 47% wollastonite, plus 680 000 t @ 39% wollastonite in a separate zone	OFR 5715, p.50
Trudeau C. Roger Young Hungerford Township	MDI31C11SW-00049 (SO 1192)	A	Calcite, dolomite	4 Mt high-purity dolomite; no reserve estimate available for the calcite zone	OFR 5958, p.11-11
Verona–Kirkham Stewart Lake Resources Inc. Bedford Township	MDI31C10SE-00023 (SO 1244)	A	Graphite	1.6 Mt grading 9.5% graphite in 2 separate zones	MDC 33, p.16
Cal Graphite Corp. Butt Township	MDI31E11NE-00004 (N0129)	AE	Graphite	Reserves of 60 Mt grading 3% graphitic carbon – Ontario Graphite Ltd. development project 2011	MDC 33, p.10
Globe Graphite Mine North Elmsley Township	MDI31C16SE-00016 (SO 1604)	I	Graphite	500 000 t of approximately 7% graphite below mined out portion to the 300-foot level	MDC 33, p.25
Cordova Mine Belmont Township	MDI31C12SW-00005 (SO 1670)	AE	Gold	115 982 tons grading 0.21 ounces per ton Au	OFR 5808, p.43
Newboro prospect North and South Crosby townships	MDI31C09NW-00009 (SO1466) MDI31C09NW-00011 (SO1469)	I	Iron, titanium	45 Mt proven and probable averaging 26.24% Fe, 6.60% TiO_2	OFR 5515, p.316
Madawaska Mine Faraday Township	MDI31F04SW-00037 (SO0223)	I	Uranium	Measured reserve of 385 193 short tons grading 0.143% U_3O_8, 1 098 283 pounds U_3O_8; indicated reserve of 450 988 short tons grading 0.158% U_3O_8, 1 427 195 pounds U_3O_8, total reserves of 836 181 short tons grading 0.151% U_3O_8, 2 525 478 pounds U_3O_8	OFR 5515, p.393
Addington Mine Kaladar Township	MDI31C11NE-00010 (SO0882)	I	Gold	Total geological reserve of 758 000 tons grading 0.14 ounces per ton Au	OFR 5808, p.71

Note: *The resource estimates listed in this table are historic figures and do not follow the required disclosure for reserves and resources as outlined in National Instrument 43-101.*

Table 15. Mineral deposits not currently being mined in the Southwestern Ontario District in 2015.

Abbreviations

AF ..... Assessment Files
AR ..... Annual Report
CAMH ..... *Canadian and American Mines Handbook*
CMH ..... *Canadian Mines Handbook*
GR ..... Geological Report
IMR ..... Industrial Mineral Report
MDC ..... Mineral Deposit Circular [No.15–] [*formerly* Mineral Resources Circular, No.1-14]
MDI ..... Mineral Deposit Inventory
MLS ..... Mining Lands, Sudbury
MR ..... Mining Recorder
NM ..... *The Northern Miner*
OFR ..... Open File Report
PC ..... Personal Communication
PRW ..... Petroleum Resources Well No.

Deposit Name / NTS	Commodity	Tonnage-Grade Estimates and/or Dimensions	Ownership References	Reserve References*	Status
Amherstburg Quarry silica prospect (40J/03SE)	Silica	20 m thick over 66 ha (20–26 $\times 10^6$ t @ 94% SiO_2)	Amherst Quarries (1969) Ltd.	OFR 5861, p.32 IMR 9, p.29, 31	Inactive
Big Creek 1 (40J/03SE)	Silica	19.5 m thick @ 25 m (10×10^6 t of sandstone)	N/A	IMR 9, p.29	Inactive
Big Creek 1 (40J/03SE)	Silica	14.6 m thick @ 34.4 m (10×10^6 t of sandstone)	N/A	IMR 9, p.29	Inactive
Dow–Moore 2-20-12 (40J/16NW)	Salt	21 m thick @ 698 m 73 m thick @ 582 m 114 m thick @ 410 m	N/A	PRW Dow–Moore 2-20-XII	Inactive
Eastnor–Lindsay prospect (41H/03SW)	Dolomite	60 $\times 10^6$ t dolomite @ <0.10% impurities (SiO_2+Fe_2O_3+Al_2O_3)	N/A	PRW OGS Lindsay 7-III W	Inactive
Imperial Oil No.560, Sombra 2-12-H, Gormlay No. 1 (40J/090NW)	Salt	32.2 m thick @ 612.6 m 84.1 m thick @ 490.7 m 46.9 m thick @ 388.6 m	N/A	PRW Sombra 2-12-H	Inactive
Imperial Oil No.597, Logierait No.1-Y-R, R.C. Fleck No. 2B (40J/16NW)	Salt	29.6 m thick @ 680 m 87.8 m thick @ 544 m	N/A	PRW Imperial Oil No. 597B	Inactive
Lindsay prospect (41H/03SW)	Dolomite	>35 $\times 10^6$ t dolomite @ <0.10% impurities (SiO_2+Fe_2O_3+Al_2O_3)	N/A	PRW OGS Lindsay 31-VIII W	Inactive
Patton Farm (40J/03SE)	Silica	5.4 m thick @ 10.1 m	N/A	IMR 9, p.29	Inactive
Sunburst GB #7 McGillivray 41-NB (40P/04NE)	Salt	88.7 m thick @ 363.6 m 5.8 m thick @ 339.5 m	N/A	PRW Sunburst GB #7	Inactive
Tobermory prospect (41H/04NE)	Dolomite	60 $\times 10^6$ t dolomite @ <0.10% impurities (SiO_2+Fe_2O_3+Al_2O_3)	N/A	PRW OGS St. Edmunds 47-III W	Inactive
Union Gas–Enniskillen No. 29, D.V.L.A. No. 1 (40J/16SW)	Salt	25.6 m thick @ 610.8 m 78.6 m thick @ 485.5 m	N/A	PRW Union Gas–Enniskillen No. 29	Inactive
Union Gas–Moore No. 12 P&I Williams No. 1 (40J/16SW)	Salt	26.2 m thick @ 577.3 m 70.7 m thick @ 456.6 m	N/A	PRW Union Gas-Moore No. 12 P&I Williams No. 1	Inactive
Union–Moore No. 22 (40J/16SW)	Salt	36 m thick @ 580 m 32 m thick @ 437 m	N/A	PRW Union Moore No. 22	Inactive

***Note:** The resource estimates listed in this table are historic figures and do not follow the required disclosure for reserves and resources as outlined in National Instrument 43-101.*

Table 16. Titanium, tantalum and REE occurrences compiled from MDI database – Southeastern Ontario District.

Name	Township	MDI File #	Commodity	Deposit Status
Harrington, Marsh Ore Bed	Marmora	MDI31C05NE00135	Au, Fe, Ti	Occurrence
Green Island Rutile	Huntingdon	MDI31C06NW00088	Ti	Occurrence
Matthews, Newboro Lake	North Crosby	MDI31C09NW00009	Fe, Ti	Past Producer with Reserves
Chaffey	South Crosby	MDI31C09NW00011	Fe, Ti	Past Producer with Reserves
Tommy Lake	North Crosby	MDI31C09NW00131	Ti	Occurrence
Ricketts	Lake	MDI31C12NE00109	Fe, Ti	Occurrence
Orton	Tudor	MDI31C12NE00122	Fe, Ti	Past Producer w/o Reserves
Hastings Road Magnetite	Tudor	MDI31C12NE00185	Fe, Ti	Occurrence
Harold White, Twin Lake	Methuen	MDI31C12NW00114	Fe, Ti	Occurrence
Horse Lake, Tripp	Methuen	MDI31C12NW00127	Fe, Ti	Occurrence
Maloney	Marmora	MDI31C12SW00002	Cr, Cu, Fe, Ni, Ti	Past Producer w/o Reserves
Canadian Nickel	Methuen	MDI31C12SW00121	Ti	Occurrence
Ridgway	Marmora	MDI31C12SW00122	Cu, Fe, Ti	Occurrence
Jocko Lake	Limerick	MDI31C13NE00107	Fe, Ti	Occurrence
Umfraville	Wollaston	MDI31C13NW00057	Co, Fe, phosphate, Ti	Occurrence
Canning Lake	Minden	MDI31D15NE00052	Fe, Ti	Occurrence
Pine Lake	Glamorgan	MDI31D16NW00215	Fe, Ni, Ti, V	Occurrence
Basin, Silver Crater (Basin)	Faraday	MDI31E01SE00054	Mica, Mo, Nb, Th, U, Ti	Past Producer w/o Reserves
Allen Lake	Harcourt	MDI31E01SE00306	Fe, Ti	Occurrence
Gal–Wood	Sabine	MDI31E08NE00010	Gd, Nb, Ta, Ti, U	Occurrence
Woodcox	Monteagle	MDI31F04NW00020	Ce, feldspar, Nb, U, Ta, Th, Ti, zircon	Past Producer w/o Reserves
Macdonald Mine	Monteagle	MDI31F04NW00023	Cu, feldspar, Mo, Nb, REE, Th, Ti, U, zircon	Past Producer w/o Reserves
Opeongo	Sebastopol	MDI31F06NE00093	Ag, Ce, Nb, Ta, Th, Ti, U, Y, zircon	Occurrence
East Rockingham	Brudenell	MDI31F06NW00085	Au, Ti	Occurrence
South Lamberts	Griffith	MDI31F06SE00161	Ti	Occurrence
Horton Tp., Ottawa River	Horton	MDI31F10SE00019	Fe, Ti	Occurrence
Mahoney and Morin	Sabine	MDI31E08SE00002	Feldspar, Nb, REE, Ta, U	Past Producer w/o Reserves
Genesee No. 2 South	Monteagle	MDI31F04NW00018	Feldspar, Nb, Si, Ta, Th, U	Past Producer with Reserves
Plunkett, Plunkett South	Monteagle	MDI31F04NW00019	Ce, feldspar, amethyst, Mo, Nb, Th, Ta, U	Past Producer w/o Reserves
Dubblestein	Bangor	MDI31F05SW00010	Nb, Ta, Th, U	Occurrence
Tooeys Lake, Tooley Lake	Brougham	MDI31F06SE00090	Nb, Ta, Th, U	Occurrence
Renfrew Minerals, Wal–Gem West Quarry	Lyndoch	MDI31F06SW00013	Be, feldspar, fluorite, Mo, Nb, REE, Si, Ta, Th, U, zircon	Producing Mine
Barr Feldspar Quarry, Woermke	Fraser	MDI31F14SW00003	Ce, feldspar, Nb, Ta, Th, U	Past Producer w/o Reserves
Quinn	Olden	MDI31C10NW00366	Cu, Ni, REE	Occurrence
Orser–Kraft	South Sherbrooke	MDI31C15SE00027	Feldspar, Nb, REE, Th, U	Past Producer w/o Reserves
Nobles Bay, Rogers, J.	North Burgess	MDI31C16SE00004	Mica, REE	Past Producer w/o Reserves
Maclaren, W.L.	North Burgess	MDI31C16SW00017	Mica, phosphate, REE	Past Producer w/o Reserves
Christie Lake	South Sherbrooke	MDI31C16SW00142	Magnetite, Nb, REE	Occurrence
Drude South	Cavendish	MDI31D09NW00079	REE, Th, U	Occurrence
Copper Anomaly	Lutterworth	MDI31D15SE00151	Cu, REE, Sr, zircon	Occurrence
Rare Earth Anomaly	Lutterworth	MDI31D15SE00152	Cu, REE, Sr, zircon	Occurrence
North Rare Earth Anomaly	Lutterworth	MDI31D15SE00153	Cu, REE, Sr, zircon	Occurrence

Name	Township	MDI File #	Commodity	Deposit Status
Laurencin, M.	Cardiff	MDI31D16NE00160	Mo, REE, Th, U	Occurrence
McLennan, J.G.	Peck	MDI31E07NE00006	Nb, REE	Occurrence
Malcovitch, P.	Clyde	MDI31E08NW00003	Ce, REE, U	Occurrence
Gole, J.G.	Murchison	MDI31E09SE00004	Feldspar, Nb, REE, Si, U, zircon	Past Producer w/o Reserves
Cameron and Aleck	Murchison	MDI31E09SE00005	Feldspar, Nb, REE	Past Producer w/o Reserves
D'Eldona, Yankee Dam	Butt	MDI31E11NE00070	Nb, REE, U	Occurrence
Plunkett North	Monteagle	MDI31F04NW00185	Feldspar, REE, U	Occurrence
Lake Clear	Sebastopol	MDI31F06NE00092	REE, Th, U	Occurrence
Price, E.C., Quadeville	Lyndoch	MDI31F06SW00014	Be, feldspar, fluorite, Nb, phosphate, REE, Si, Th, U, zircon	Producing Mine
Universal Light Metals	Lyndoch	MDI31F06SW00065	Be, Ce, Nb, REE, Th, U	Occurrence
Lake Property, Lake Mine	Dickens	MDI31F12SW00006	Feldspar, REE	Past Producer w/o Reserves

Note: *MDI database was queried for Ti, Ta and REE occurrences. This listing indicates the presence of the commodities, not necessarily their order of abundance. This list should be used as a preliminary guide only. Hard copies of these complete MDI files are located at RGP office in Tweed.*

OGS ACTIVITIES AND RESEARCH BY OTHERS

Multi-year mapping and related projects in southern Ontario by staff of the Earth Resources and Geoscience Mapping Section, Ontario Geological Survey, continued during the 2015 field season.

In the northeastern part of the Central Metasedimentary Belt, Grenville Province, 2 bedrock geology mapping projects were started: a two-year project in the Perth area and a one-year project in the Centennial Lake area. Details of work done in 2015 on OGS and collaborative projects in the Central Metasedimentary Belt are presented in the following articles, published in *Summary of Field Work and Other Activities 2015* (Ontario Geological Survey 2015):

- Precambrian and Paleozoic Geology of the Perth Area, Grenville Province; by R.M. Easton
- Geology and Mineral Potential of the Centennial Lake Area, Northeastern Central Metasedimentary Belt, Grenville Province; by M. Duguet, Q. Duparc and C. Mayer

Four new geological maps from the Central Metasedimentary Belt were published in 2015:

- Preliminary Map P.3781, *Precambrian Geology of the Chenaux Gabbro, Grenville Province*; by B. Azar and R.M. Easton
- Preliminary Map P.3791, *Precambrian Geology of Eastern Ontario Interpreted from Aeromagnetic and Compiled Geological Data—Northwest Sheet*; by S.J. Magnus and R.M. Easton
- Preliminary Map P.3792, *Precambrian Geology of Eastern Ontario Interpreted from Aeromagnetic and Compiled Geological Data—Northeast Sheet*; by S.J. Magnus and R.M. Easton
- Preliminary Map P.3793, *Precambrian Geology of Eastern Ontario Interpreted from Aeromagnetic and Compiled Geological Data—South Sheet*; by S.J. Magnus and R.M. Easton

One new geological report from the Central Metasedimentary Belt was published in 2015:

- Open File Report 6299, *Geology, Geochemistry and Mineral Potential of the Chenaux Gabbro, Northeastern Central Metasedimentary Belt, Grenville Province*; by B. Azar

Other OGS studies related to Paleozoic geology and energy studies, Quaternary geology, aggregate resources and groundwater resources in southern Ontario were in progress in 2015. Detailed descriptions are included in *Summary of Field Work and Other Activities 2015* (Ontario Geological Survey 2015).

Aggregate Resources and Industrial Minerals

- Aggregate Resources Inventory of the County of Elgin, Southwestern Ontario; by V.L. Lee

Surficial Mapping and Sampling

- An Update on Three-Dimensional Mapping of Quaternary Deposits in the Central Part of the County of Simcoe, Southern Ontario; by R.P.M. Mulligan

Paleozoic Geology and Energy Studies

- Upper Silurian–Middle Devonian Core Logging and Bedrock Groundwater Mapping along the Onondaga Escarpment, Southwestern Ontario; by S. Sun, F.R. Brunton and J. Jin

Groundwater Studies

- Quaternary Stratigraphy of the Niagara Peninsula Revealed with Three-Dimensional Mapping; by A.K. Burt
- Filling Groundwater Data Gaps in the Niagara Region to Assist Decision-Making Processes; by J.D. Campbell and A.K. Burt
- Geochemical and Isotopic Sampling to Delineate Sources of Highly Mineralized Groundwater on the Niagara Peninsula; by C.A. McEwan, S.M. Hamilton and G.F. Slater
- Township of Alfred and Plantagenet Groundwater Study; by T. Di Iorio, A.J. Lemieux and S.M. Hamilton

Geophysical surveys that were completed or in progress in southern Ontario in 2015 are described in *Summary of Field Work and Other Activities 2015* (Ontario Geological Survey 2015).

- Summary of Geophysical Projects and Activities; by D.R.B. Rainsford and S. Biswas

One geophysical survey in southern Ontario was released in 2015:

- Ground gravity survey in the central Simcoe County area:
  Geophysical Data Set 1080 and Maps 82 770 to 82 771 (1:50 000 scale)

Other publications released in 2015 related to aggregate, energy and groundwater resources in southern Ontario are

- Aggregate Resources Inventory Paper 69, *Aggregate Resources Inventory of Central and Eastern Parts of the District of Parry Sound, Central Ontario*; by D.J. Rowell
- Aggregate Resources Inventory Paper 165 – Revision, *Drift Thickness Data (2015 Update) for the Caledon Village–Sleswick–Mono Mills Area, Regional Municipality of Peel, Southern Ontario*; by Ontario Geological Survey
- Open File Report 6307, *Aggregate and Industrial Mineral Potential of the Guelph Formation, Southern Ontario*; by D.J. Rowell
- Open File Report 6310, *Workshop Summary and Gap Analysis Report: Unifying Groundwater Science in Southern Ontario*; by H.A.J. Russell, E.H. Priebe and J.R. Parker
- Open File Report 6312, *Upper Ordovician Organic-Rich Mudstones of Southern Ontario: Drilling Project Results*; by C. Béland Otis
- Miscellaneous Release—Data 324, *Results of 2011–13 Overburden Drilling Programs in the Southern Part of the County of Simcoe, South-Central Ontario*; by A.F. Bajc, R.P.M. Mulligan, D.R.B. Rainsford and J.L. Webb
- Miscellaneous Release—Data 326, *Geological, Geochemical and Geophysical Data from the Ordovician Shales Drilling Program and the Regional Sampling Program, Southern Ontario*; by C. Béland Otis
- Miscellaneous Release—Data 283–Revised, *Ambient Groundwater Geochemistry Data for Southern Ontario, 2007–2014*; by S.M. Hamilton

University Research and Collaborations

The following information was provided to the Southern Ontario Regional Resident Geologist's office concerning research projects by faculty and graduate students of various accredited universities, which were in progress or were published in 2015 and in early 2016. This section is not a comprehensive summary of university research in the Southeastern Ontario and Southwestern Ontario districts, as it is based solely on information provided directly by university researchers.

- S. Mathur (University of Toronto) completed an MSc thesis, supervised by Dr. E. Spooner, entitled, "The Geochemistry of the Marmoraton Fe Skarn and Associated Syenodiorite Intrusion, Grenville Province, S. Ontario".
- Dr. W.M. Schwerdtner (University of Toronto), Dr. C.J.S. (Toby) Rivers (Memorial University of Newfoundland), and S. Page (Lassonde Institute of Mining, University of Toronto) conducted field studies in the southern Algonquin and Georgian Bay regions of the Grenville Province, examining evidence for penecontemporaneous ductile flow and brittle fracture in granulite- to amphibolite-facies metamorphic rocks of the Grenville Province.

  Dr. Rivers and Dr. Schwerdtner also continued their multi-year studies on the evolution of structural domains within the Ottawa River Gneiss Complex (Central Gneiss Belt) in 2015, conducting field work in the Mattawa–Pembroke–Barry's Bay area. Recent work has led to some revisions of the original interpretation by presenting evidence that, rather than being associated primarily with crustal thickening and prograde metamorphism during construction of the thrust stack, structural domains developed in a regime of exhumation, crustal thinning, and retrogression during orogenic collapse (Rivers and Schwerdtner 2015; and other work in progress).
- Dr. B. Kendall and MSc thesis students Jieying Wang and Ryan Truong (University of Waterloo) are measuring redox-sensitive trace metal concentrations (e.g., Mo, Re, U) and molybdenum and uranium isotope compositions of the Ordovician and Devonian black shales in southern Ontario, specifically the Rouge River Member and Kettle Point Formation. The goal is to reconstruct the local, regional and global extent of ocean anoxia versus oxygenation during shale deposition, with possible implications for shale gas concentration.

The following projects by faculty and students at Carleton University were in progress in 2015:

Student	Research Topic(s)
PhD Theses	
E. Amin (*in progress*)	2-D and 3-D basin modeling of ground motion simulation for nonlinear soil in eastern Canada Supervisor: Dr. D. Motazedian
S. Crane (*in progress*)	Numerical modelling of seismic wave propagation through a soft soil basin in Kinburn, Ontario Supervisors: Dr. D. Motazedian and Dr. J. Hunter (Geological Survey of Canada)
S. Davey (*in progress*)	Assessment of Paleoproterozoic sill and dyke provinces in formerly adjacent fragments of Canada and Finland/Russia toward reconstructing the supercraton Superia Supervisors: Dr. R.E. Ernst, Dr. B. Cousens and Dr. W. Bleeker (Geological Survey of Canada)
N. Oruche (*in progress*)	Middle to Upper Ordovician foreland sequence stratigraphy, Ottawa Embayment Supervisor: Dr. G.R. Dix
MSc Theses	
S. Hayek *(in progress)*	The role of 3-D effects on ground motions observed over soft-sediment–filled bedrock basins in the Ottawa region Supervisors: Dr. D. Motazedian and Dr. J. Hunter (Geological Survey of Canada)
BSc (Hon.) Theses	
K. Chadirji-Martinez *(in progress)*	Origin and geochemistry of wrench-fault calcite veins, western Ottawa Supervisor: Dr. G.R. Dix
A. Laudadio *(in progress)*	Petrographic and geochemical study of Proterozoic metavolcanic rocks surrounding the Lavant gabbro complex, Darling and Carleton Place areas, eastern Ontario Supervisors: Dr. B. Cousens and Dr. R.M. Easton (Ontario Geological Survey)

REGIONAL LAND USE GEOLOGIST ACTIVITIES—SOUTHERN REGION

Land Use Planning Activities

The southern Regional Land Use Geologist, based in Tweed, co-ordinates input into land use planning activities in the Southern Ontario Resident Geologist District (southeastern Ontario and southwestern Ontario districts) and the part of the Sudbury District south of the French River, including Manitoulin and St. Joseph Islands. The southern Regional Land Use Geologist position was staffed throughout 2015 by D.A. Laidlaw, *P.Geo.*

The boundaries of the Regional Land Use Geologists' regions are indicated in Figure 11.

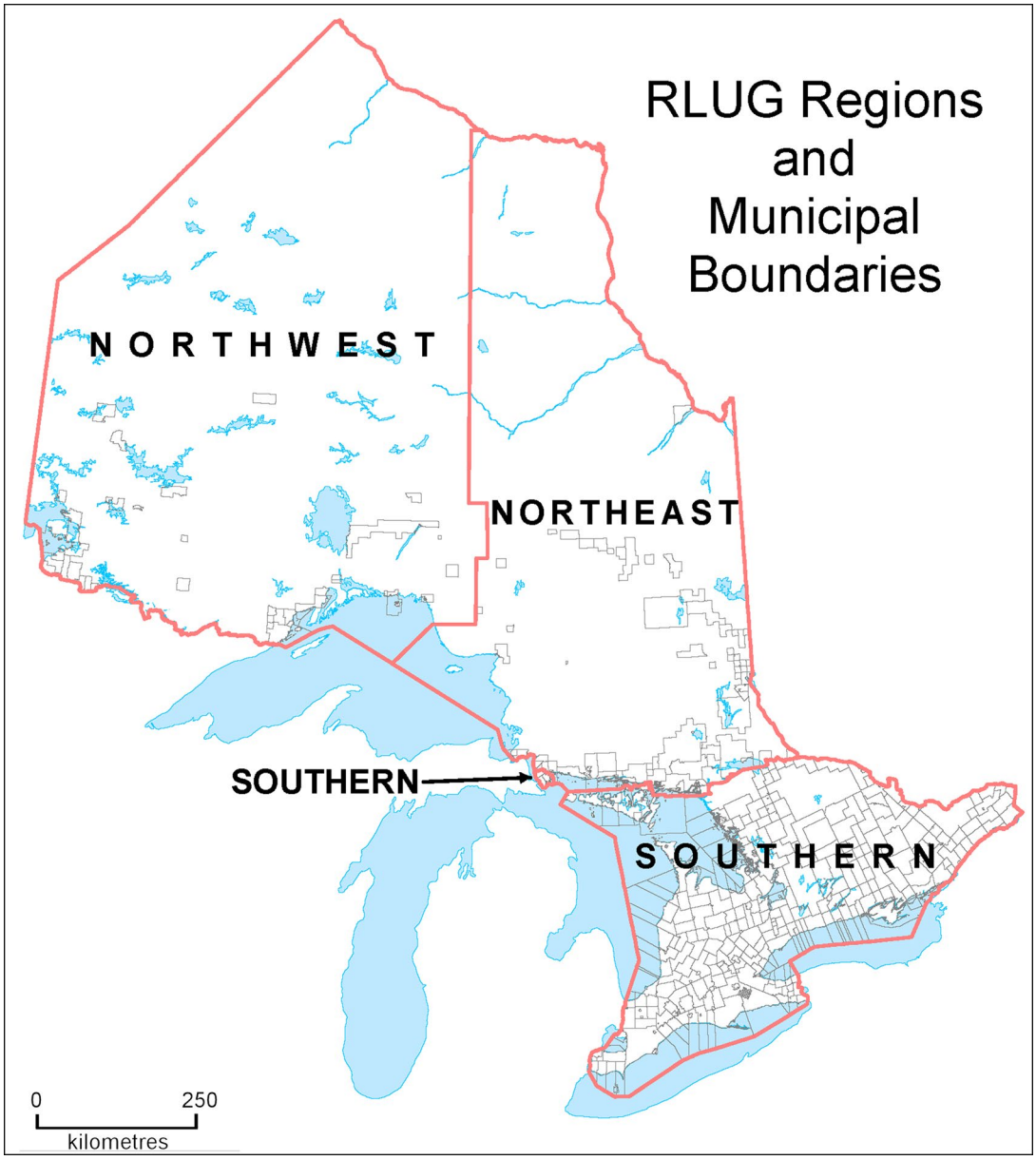

Figure 11. Extent of Regional Land Use Geologists' areas of responsibility (red lines indicate the regional boundaries; grey lines indicate the municipal boundaries).

The objective of the position is to ensure that geoscience information is considered in policy and land use planning decisions. The geoscience information relates to

- mineral-related values and economic opportunities;
- natural geological and mining-related hazards;
- renewable and non-renewable energy sources; and
- groundwater resources.

Program activities that support this objective include helping develop, deliver and administer provincial policies, practices and procedures; and providing advice and guidance to municipalities, agencies and others involved in or affected by land-use planning regarding geoscience-related matters.

In 2015, the southern Regional Land Use Geologist dealt with a variety of land use planning issues throughout the southern region. The following sections summarize the work that was done.

CROWN LANDS

The Ministry of Northern Development and Mines (MNDM) engages with the Ministry of Natural Resources and Forestry (MNRF) when Crown land use planning activities have the potential to impact provincial mineral interests, or to expose those using Crown lands to natural geological or mining-related hazards. These activities relate to forest management planning; energy and other major infrastructure projects; Far North land use planning; proposals to modify existing parks or create new ones; and various other initiatives related to Crown land use.

Forest Management Planning

The forest management planning process involves consideration of a wide range of values including mineral values in the context of forestry activities, and the relevance of legislation other than the *Crown Forest Sustainability Act*, including the *Mining Act*. The southern Regional Land Use Geologist normally provides input into the development of forest management plans. However, because of the planning cycle for forest management planning, the southern Regional Land Use Geologist was not required to provide input into planning for any of the 5 forest management units in southern Ontario in 2015.

Approved forest management plans, with detailed information about annual operations including plans for creating new access routes or decommissioning existing routes, and maps showing forest access roads are posted on the MNRF Web site (www.efmp.lrc.gov.on.ca/eFMP/home.do).

Provincial Parks and Conservation Reserves

In 2015, the southern Regional Land Use Geologist responded to a request for comments on a review of 1 provincial park management plan, the update of the Frontenac Provincial Park Management Plan. The review addresses topics such as zoning, park uses, management of cultural and natural resources, and access. The MNRF posted the update of this park management plan on the Environmental Registry in 2015 for public comment, but no decision notice on the final outcome has been released.

Withdrawal Orders

Work related to Crown land use in the southern region included a review of an application for withdrawal of lands from staking under Section 35 of the *Mining Act*. This application was for both surface and mining rights. The request was made to address an Addition to Reserve process for a First Nation community south of Parry Sound.

The review by the southern Regional Land Use Geologist ensured that mineral potential, mineral sector activity and mining-related hazards are identified and considered before decisions were made.

Table 17. Municipal planning initiatives with MNDM input, southern Ontario, 2015.

Consent (Severance) Applications	Completed Official Plans and Related Initiatives	Official Plans and Related Initiatives Under Development
Barrie, Township of	Huntingdon, Township of	Gravenhurst, Town of
Bastard, Township of	Kawartha Lakes, City of (2)	Haliburton, County of
Bathurst, Township of (2)	Kingston, City of	Kingston, City of
Burgess, Township of (3)	Lanark, County of	Laurentian Hills, Town of
Elzevir, Township of (2)	Lennox and Addington, County of	Nipissing, Township of
Goderich, Town of (4)	London, City of (2)	Northeastern Manitoulin and the Islands, Town of
Herschel, Township of	Nipissing, Township of	Prescott, Town of
Madoc, Township of (4)	Northeastern Manitoulin and the Islands, Town of	The Archipelago, Township of
North Crosby, Township of	Pembroke, Town of	York, Regional Municipality of
Olden, Township of	Renfrew, County of	
South Burgess, Township of	Sherburne, Town of (2)	
	South Frontenac, Township of	
	Trent Hills, Municipality of (2)	
	York, Regional Municipality of	

MUNICIPAL AND PRIVATE LANDS

The Ministry of Northern Development and Mines supports municipal and private land use planning through the One Window Planning Service led by the Ministry of Municipal Affairs and Housing (MMAH). When requested, the southern Regional Land Use Geologist provides input into, and reviews, draft Official Plans, Official Plan Amendments, draft plans of subdivision and consent (severance) applications to ensure that provincial mineral interests, natural geological hazards and mining-related hazards are appropriately considered in the planning process.

Municipal Planning

The Provincial Policy Statement (PPS), which guides municipal planning in Ontario, is issued under the provisions of the *Planning Act*. The PPS was last modified in 2014. The revision includes enhanced provisions to help ensure that municipal Official Plans recognize mining operations and areas with significant mineral potential, so that they can be protected from incompatible land uses.

In 2015, the southern Regional Land Use Geologist reviewed, commented on and/or supplied data and expertise for 21 consent (severance) applications in 11 lower tier municipalities; 18 Official Plans and related planning initiatives (such as zoning by-laws and subdivision approvals) in 14 communities; and 9 new draft Official Plans or Official Plan updates. The municipalities involved in these planning ititiative are listed in Table 17; their locations are shown in Figures 12 and 13.

The southern Regional Land Use Geologist attended the Northeastern Ontario Planning Authorities Workshop to network with clients and service providers engaged in municipal planning. This event covers part of the southern Regional Land Use Geologist's region.

Data Committee

The MNRF and the MMAH jointly host the Planning Systems Data Committee. It is an interministerial committee that is intended to identify and implement ways to make relevant data more readily available to support land use planning in Ontario, especially in the context of municipal planning. The southern Regional Land Use Geologist continued to serve as MNDM's representative on the committee in 2015. During the year, the committee launched its pilot project to test functionality and completeness of its draft data catalogue in the review of 2 Official Plans by ministry planners. The catalogue was developed as a baseline inventory of data available for use by planning authorities.

Other Activities

The southern Regional Land Use Geologist also undertook other related work in 2015, as outlined below.

INVESTMENT READY SITES

Ontario's "Investment Ready: Certified Site" program, operated by the Ministry of Economic Development, Employment and Infrastructure promotes an inventory of sites that may be of interest to potential investors and purchasers. It pre-screens the suitability of sites for development, and provides detailed information about the sites' access to utilities and transportation, and their environmental status. In 2015, the southern Regional Land Use Geologist provided information for 13 candidate sites for certification in southern Ontario.

CLASS ENVIRONMENTAL ASSESSMENTS

Class Environmental Assessments ("Class EAs") are documents that set out a standard environmental assessment process to evaluate the potential environmental effects of a project. There are currently 11 Class EAs in effect in Ontario, with regard to initiatives including the development of new infrastructure, such as dams, transmission lines, pipelines, highway corridors, commuter rail stations and bus terminals, and sewer and water facilities; the establishment of new parks and conservation reserves; forest management plans; and Crown land dispositions.

The southern Regional Land Use Geologist worked with staff from MNRF and other ministries to ensure that relevant geoscience information and provincial mineral interests were identified and accommodated

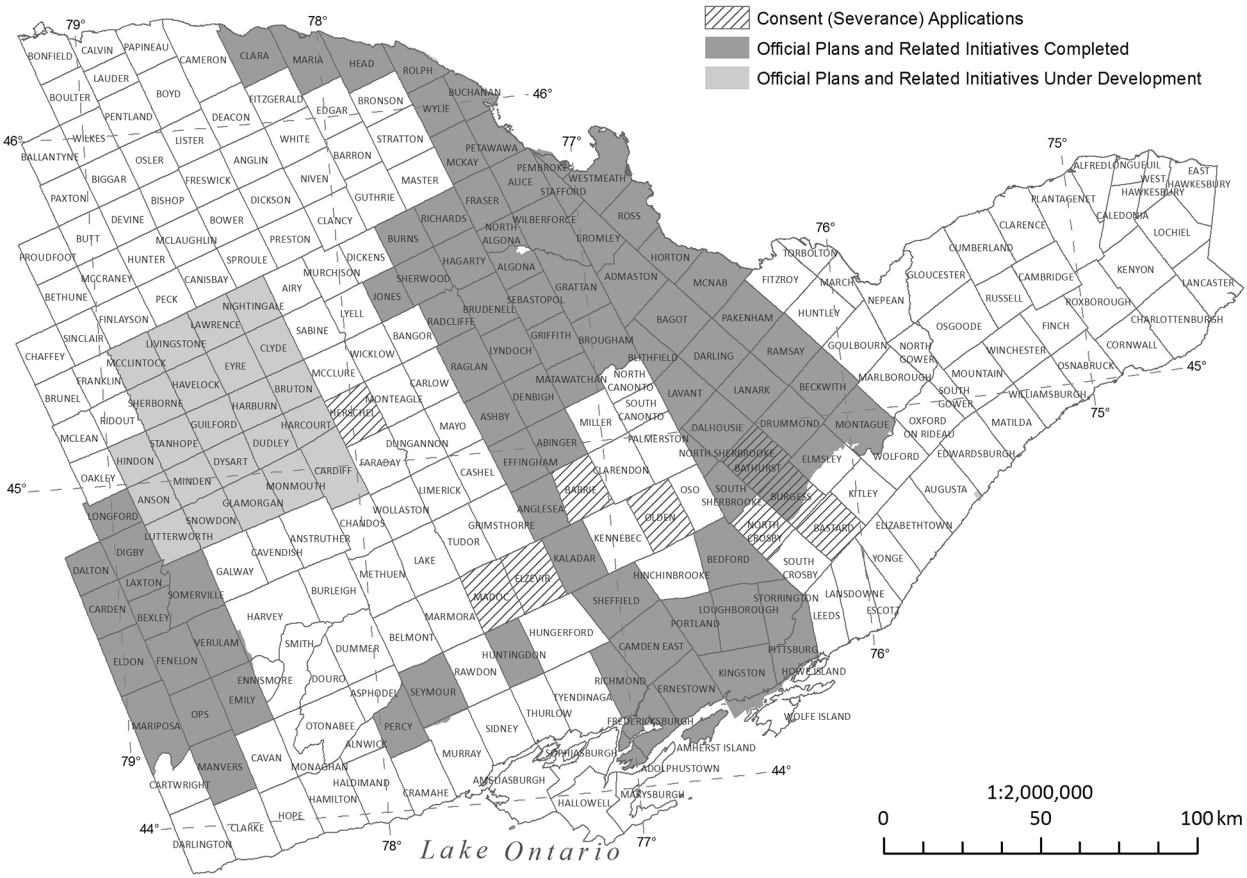

Figure 12. Planning initiatives with MNDM input, southeastern Ontario.

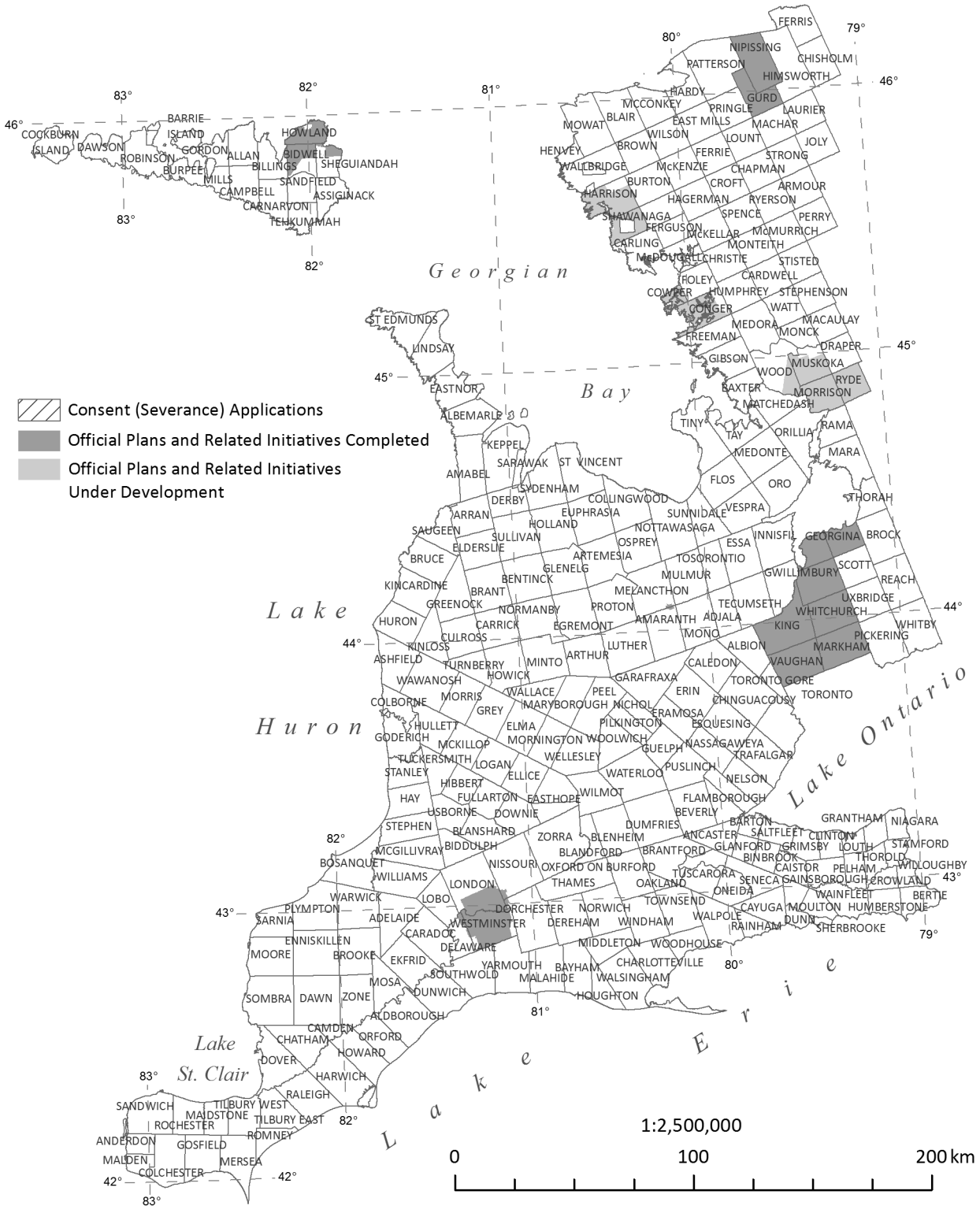

Figure 13. Planning initiatives with MNDM input, southwestern Ontario.

early in the planning process of projects subject to Class EAs. In 2015, feedback was provided for reviews of the following 12 Class EAs projects within southern Ontario:

- Britannia Avenue West road extension in Whitby;
- Capital Region Resource Recovery Centre, Ottawa area;
- Highway 6 improvement near Hagersville;
- expansion of Eastern Ontario Waste Handling Facility, Moose Creek;
- Ouse River Bridge replacement, on Highway 7 near Norwood;
- TransCanada's King's North pipeline connection project, Greater Toronto Area;
- natural gas pipeline project, Fenelon Falls;
- Trillium line transit extension project, City of Ottawa;
- Highway 401 collector lane rehabilitation, Toronto;
- natural gas pipeline project to serve Seaton land development;
- replacement of QEW bridges, Fort Erie and Niagara Falls; and
- natural gas pipeline projects, southern Bruce County.

GUIDANCE MATERIALS

In 2015, the southern Regional Land Use Geologist was called upon by partner ministries to review and provide input on proposed new or updated policies, and/or supporting guidance materials. Comments were prepared and submitted for the following

- reference and support materials for municipal planners using the Provincial Policy Statement;
- Guidelines for Permitted Uses in Ontario's Prime Agricultural Areas;
- One Window Implementation Components including Screening Criteria and Technical Studies;
- Ministry of the Environment and Climate Change Guidelines for Land Use Compatibility replacing D-Series Guidelines; and
- one-page information sheets for Sections 2.4 and 3.2 of the Provincial Policy Statement.

ONTARIO BIODIVERSITY STRATEGY

The Ontario Public Service (OPS) Biodiversity Network is an interministry forum led by MNRF's Biodiversity Branch. It allows members to exchange information and plan for biodiversity-related policies, processes, projects and activities across the Province to help implement the Ontario Biodiversity Strategy. The strategy itself was developed by the Ontario Biodiversity Council, a non-governmental organization.

The southern Regional Land Use Geologist along with R.L. Debicki, *P.Geo.,* Land Use Policy and Planning Co-ordinator and G. Lo, Policy Advisor, represented MNDM on the OPS Biodiversity Network by attending teleconferences and providing input to biodiversity-related initiatives. The southern Regional Land Use Geologist also attended Ontario's first Biodiversity Summit and launch of the State of Ontario's Biodiversity 2015 Report in Niagara Falls.

CONFERENCES

The southern Regional Land Use Geologist engaged with clients at the Bancroft Gemboree. With approximately 5000 attendees each year, the Bancroft Gemboree is the largest gem and mineral show in Canada. It provides staff from the Resident Geologist Program with an opportunity to share information regarding the mineral sector with mineral collectors and the general public.

The southern Regional Land Use Geologist also attended 2 mini-symposia hosted by the Toronto Geological Discussion Group. The half-day semi-annual sessions highlight recent advances in the application of exploration techniques, geology and mineral deposits.

MINERAL DEPOSIT COMPILATION GEOLOGIST—NORTHEASTERN ONTARIO

The Mineral Deposit Compilation geologists (MDCG) investigate and document mineral deposits and occurrences across the province. Through field visits, comprehensive literature research and personal research, they work with regional and district Resident Geologist Program staff to ensure that the Mineral Deposit Inventory (MDI) database is regularly updated. Regular updates are required to ensure that the Ministry of Northern Development and Mines is using the most up-to-date information in making land-use planning and policy decisions. A.C. Wilson is the current northeastern Ontario MDCG.

Throughout the year, emphasis was placed on updating MDI records for the Far North Land Use Planning Geoscience Atlases initiative. Additional records were corrected with updated and properly ranked commodities. A focus was also made on updating MDI records for the Black River–Matheson land-use planning update. To date, data for 6 of the townships have been compiled and entered into the database.

Complete township updates were compiled and entered for Bond, Bowman, Cairo, Carr, Currie, Harker, Powell, Stock and Taylor, in the Larder Lake Mining Division. Complete township updates were also compiled and entered for Bastard, Beckwith, Burgess, Dalhousie, Drummond, Elmsley, Kitley, Montague, North Crosby and South Sherbrooke, in the Southern Ontario Mining Division. These townships were part of a mapping project conducted by R.M. Easton of the Ontario Geological Survey. The northeastern MDCG also worked on changes and updates to MDI records for a variety of land use planning decisions in the Larder Lake Mining Division and the Sault Ste. Marie Mining Division.

Total changes to the provincial MDI database, completed by the MDCG—Northeastern Ontario, in 2015 included 531 updated records, 87 records deleted and 14 new records. A breakdown, by office, of the provincial records revised by the Mineral Deposit Compilation Geologist—Northeastern Ontario is provided in Table 18.

Table 18. Mineral Deposit Inventory records revisions in 2015.

Resident or District Office	Updates	Deletions	New
Thunder Bay North	1	0	0
Kirkland Lake	183	13	8
Sault Ste. Marie	10	0	0
Southeastern Ontario	276	73	4
Sudbury	1	1	0
Timmins	64	0	2
Total	535	87	14

The MDI database is a dynamic compilation of over 19 000 records describing most of the known mineral occurrences in Ontario. It is an important reference tool for explorationists interested in exploring and acquiring mining properties in Ontario. When used in conjunction with other spatial databases generated by the Ontario Geological Survey, it provides additional tools for making mineral discoveries in Ontario.

The MDI database was updated in February 2016 (Ontario Geological Survey 2016) and is available from the OGS online data warehouse—GeologyOntario (www.ontario.ca/geology). The Mineral Deposit Inventory can also be viewed geographically using the OGSEarth application (www.ontario.ca/ogsearth), which helps users with data discovery through a graphical interface (keyhole mark-up language (*.kml*) files for use with applications, such as Google Earth™ mapping service).

ACKNOWLEDGMENTS

The authors from the Southern Ontario Regional Resident Geologist's office would like to recognize 2 colleagues for their contributions to this report. A.C. Wilson, Mineral Deposit Compilation Geologist, provided the summary, "Mineral Deposit Compilation Geologists—Northeastern Ontario". R.L. Debicki, Land Use Planning and Policy Co-ordinator, provided a provincial perspective to the contribution by the southern Regional Land Use Geologist.

The authors would like to thank all producers, exploration companies, prospectors and developers who provided access to their operations or supplied information throughout 2015. Strong communication links between stakeholder groups and government ministries are essential for effective program delivery and ultimately improve the delivery of government services.

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Ontario

Ontario Geological Survey
Regional Resident Geologist Program

Petroleum Operations Section—2015

by

L. Fortner

2016

CONTENTS

Petroleum Operations—2015

Petroleum Operations Section—2015

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INTRODUCTION

After a perceived plateau in the decline of drilling activity in southern Ontario from 2011 to 2013, drilling frequency surprised to the downside in 2014 and remained at that level for 2015. In terms of exploration and development, activity in 2015 approached zero. As noted by the Oil, Gas and Salt Resources Library, 2015 was the first year of recorded petroleum activity in which no oil wells, exploration or development, were drilled. It may be the first year since the commercial industry began in Ontario in 1858 without an oil well.

The average price of oil sold in Ontario during the year was $61 per barrel: more than a third off of the average of $98 in 2014. The price of natural gas in Ontario averaged $2.95 per MMBtu in 2015, significantly lower than the average of $5.52 per MMBtu in 2014.

Produced oil volumes fell to a new low again in 2015. Data compiled from annual production reports submitted to the Petroleum Operations Section indicate that annual oil production dropped 18.7% to 55 457 m^3 in 2015, compared with 68 212 m^3 in the previous year. Of greater impact to operators was the price per unit volume of oil, which resulted in an estimated total sales value of $21.8 million, approximately half of the estimated value of $42.3 million in 2014.

The continuing decline in oil production is directly related to reduced levels of drilling activity since 2004, such that there is insufficient new production to replace that from older existing wells. Suppression of the price of oil, which began in 2014, combined with the longer term pressure on the price of natural gas, has almost entirely eliminated new petroleum drilling in the province.

Natural gas production exhibited its smallest volume decline in several years, falling only 2.8% from a revised production of 161 100 $\times 10^3$ m^3 in 2014 to 160 648 $\times 10^3$ m^3 in 2015. However, much lower unit gas prices during 2015 limited the benefit for operators of maintaining production rates, with an estimated total value of $17.2 million in 2015, as compared with a revised total value of $32.1 million in 2014.

ACTIVITY

A total of 11 licences to drill and operate new wells were issued by the Ministry of Natural Resources and Forestry in 2015, compared with 10 in 2014. An additional 43 licences were issued to plug or operate existing wells, compared with only 20 in 2014.

Drilling of 6 new wells was reported in 2015, an outcome relatively unchanged from the 7 drilled in 2014. These consisted of 1 development well, 2 natural gas storage wells, and 3 stratigraphic tests. This activity contrasts with the 1 exploratory well, 4 development wells, 1 solution mining well, and 1 observation well drilled in 2014. Although a similarly small total number, the 2014 activity was weighted toward exploration and development.

The single development drilling effort in 2015 was a technical success reported as an active gas producer. The commercial development success rate in 2015 was a further drop from the 1 active oil producer and 2 potential oil wells reported in 2014.

Petroleum exploration activity in Ontario declined to zero last year, with no exploratory wells drilled in 2015. This followed from only a single exploration well in 2014.

Cambrian Play

As in 2014, no exploratory wells were drilled to test Cambrian targets for oil and gas in 2015.

No development wells were drilled to test the Cambrian in 2015. There had been 1 development well drilled to this target in 2014, which had been the first since 2010.

Ordovician Play

There were no exploration wells drilled to an Ordovician target in 2015, after a single effort in 2014.

No Ordovician development wells were drilled in 2015 to follow the single horizontal development well from 2014.

Silurian Sandstone Play

No exploration wells have been drilled to test Silurian sandstone targets since 2011.

The only well of note in 2015 was 1 development well drilled for Silurian sandstone. It was reported as an active gas well in Elgin County. One development well had also tested these targets in 2014.

Silurian Carbonate Play

There were no exploratory wells drilled to test Silurian Guelph Formation reef and/or Salina Group targets in 2015 or 2014.

There were also no development wells drilled for this play in 2015 or 2014.

Devonian Play

No exploration wells tested Devonian targets in 2015 or 2014.

No development wells were drilled to test the Devonian in 2015. There had been 1 development well drilled for the Devonian in 2014.

EXPLORATION TRENDS

North American natural gas prices have maintained their weakness for several years because of oversupply from the United States. Low natural gas prices have a dramatic impact on exploration and development activity in Ontario, which has now been essentially halted. Exploration activity focussing on oil had not increased significantly in the past few years in spite of oil prices that remained robust until 2014. With North American oil prices finishing the year below $40, what limited interest there had been for oil drilling has also disappeared. Consensus amongst industry analysts regarding the near future of oil and gas prices is not optimistic.

Metric Conversion Table

Conversion from SI to Imperial			Conversion from Imperial to SI		
SI Unit	*Multiplied by*	*Gives*	*Imperial Unit*	*Multiplied by*	*Gives*
		LENGTH			
1 mm	0.039 37	inches	1 inch	**25.4**	mm
1 cm	0.393 70	inches	1 inch	**2.54**	cm
1 m	3.280 84	feet	1 foot	**0.304 8**	m
1 m	0.049 709	chains	1 chain	20.116 8	m
1 km	0.621 371	miles (statute)	1 mile (statute)	**1.609 344**	km
		AREA			
1 cm^2	0.155 0	square inches	1 square inch	**6.451 6**	cm^2
1 m^2	10.763 9	square feet	1 square foot	**0.092 903 04**	m^2
1 km^2	0.386 10	square miles	1 square mile	2.589 988	km^2
1 ha	2.471 054	acres	1 acre	0.404 685 6	ha
		VOLUME			
1 cm^3	0.061 023	cubic inches	1 cubic inch	**16.387 064**	cm^3
1 m^3	35.314 7	cubic feet	1 cubic foot	0.028 316 85	m^3
1 m^3	1.307 951	cubic yards	1 cubic yard	0.764 554 86	m^3
		CAPACITY			
1 L	1.759 755	pints	1 pint	0.568 261	L
1 L	0.879 877	quarts	1 quart	1.136 522	L
1 L	0.219 969	gallons	1 gallon	**4.546 090**	L
		MASS			
1 g	0.035 273 962	ounces (avdp)	1 ounce (avdp)	28.349 523	g
1 g	0.032 150 747	ounces (troy)	1 ounce (troy)	**31.103 476 8**	g
1 kg	2.204 622 6	pounds (avdp)	1 pound (avdp)	**0.453 592 37**	kg
1 kg	0.001 102 3	tons (short)	1 ton(short)	**907.184 74**	kg
1 t	1.102 311 3	tons (short)	1 ton (short)	**0.907 184 74**	t
1 kg	0.000 984 21	tons (long)	1 ton (long)	**1016.046 908 8**	kg
1 t	0.984 206 5	tons (long)	1 ton (long)	**1.016 046 9**	t
		CONCENTRATION			
1 g/t	0.029 166 6	ounce (troy) / ton (short)	1 ounce (troy) / ton (short)	34.285 714 2	g/t
1 g/t	0.583 333 33	pennyweights / ton (short)	1 pennyweight / ton (short)	1.714 285 7	g/t

OTHER USEFUL CONVERSION FACTORS

	Multiplied by	
1 ounce (troy) per ton (short)	31.103 477	grams per ton (short)
1 gram per ton (short)	0.032 151	ounces (troy) per ton (short)
1 ounce (troy) per ton (short)	20.0	pennyweights per ton (short)
1 pennyweight per ton (short)	0.05	ounces (troy) per ton (short)

*Note: Conversion factors in **bold** type are exact. The conversion factors have been taken from or have been derived from factors given in the* Metric Practice Guide for the Canadian Mining and Metallurgical Industries*, published by the Mining Association of Canada in co-operation with the Coal Association of Canada.*

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