ISSN 1916-6168 (online)
ISBN 978-1-4868-6798-1 (PDF)

ISSN 1484-9402 (print)
ISBN 978-1-4868-6797-4 (print)

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Report of Activities, 2022 Resident Geologist Program

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

2023

Ontario

ONTARIO GEOLOGICAL SURVEY

Open File Report 6404

Report of Activities, 2022
Resident Geologist Program

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

by

L.A. Mancini, M. Dorado-Troughton, J. Swiercz, P.S. LeBaron, S.L.K. Hinz, N. Sabiri, G. Dorland and L. Fortner

2023

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ISBN 978-1-4868-6797-4 (print)
ISBN 978-1-4868-6798-1 (PDF)

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Mancini, L.A., Dorado-Troughton, M., Swiercz, J., LeBaron, P.S., Hinz, S.L.K., Sabiri, N., Dorland, G. and Fortner, L. 2023. Report of Activities 2022, Resident Geologist Program, Southern Ontario Regional Resident Geologist Report: Southeastern Ontario and Southwestern Ontario Districts and Petroleum Operations; Ontario Geological Survey, Open File Report 6404, 78p.

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ONTARIO GEOLOGICAL SURVEY

RESIDENT GEOLOGIST PROGRAM

REPORT OF ACTIVITIES—2022

SOUTHERN ONTARIO
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INTRODUCTION

The Southern Ontario Region comprises the Southeastern Ontario and Southwestern Ontario districts and encompasses the most populous part of the province and the country. The Region also includes both the provincial and national capitals. The region stretches over 800 km and is bordered by the Canada–United States border in the west, the south and the southeast, through the southern Great Lakes (lakes Huron, Erie and Ontario) and along the St. Lawrence River. To the east and northeast, the region is bordered by the provincial border between Quebec and Ontario. The northern boundary of the region cuts through Georgian Bay, and then eastward north of Lake Simcoe, including Algonquin Park and neighbouring townships.

Geologically, Paleozoic sedimentary rocks cover the southern and parts of the easternmost portions of the districts, whereas Proterozoic metamorphic rocks of the Central Metasedimentary Belt and Central Gneiss Belt of the Grenville Province occupy the northern and parts of the eastern portions. Consequently, the region hosts some of the most diverse and productive geology in the province of Ontario.

Production from mines and quarries continued throughout southern Ontario, within both the Grenville Province metamorphic terrane and in the Paleozoic sedimentary rocks of the Region. With the exception of salt mining and brine field operations in Goderich and Windsor, and the Hagersville gypsum mine, all mining operations within the Paleozoic sedimentary rocks are for commodities, the development of which is designated under the *Aggregate Resources Act* administered by the Ministry of Natural Resources and Forestry.

Tables 4 through 7 and Tables 19 through 23 provide details on currently inactive mineral deposits with identified resources and past-producing mineral occurrences. Please note that unless otherwise stated, the resource figures presented in these tables and elsewhere in this report refer to historical resources that are not compliant with National Instrument (NI) 43-101.

The authors note that all Web addresses referenced were accessed in January and February 2023, unless otherwise noted. Dollar amounts are provided as Canadian, unless otherwise indicated.

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

MINING AND QUARRYING ACTIVITY

During 2022, there were well over 100 mineral extraction operations in southern Ontario, including 67 dimension stone quarries, 16 specialty aggregate producers (for pavement, decorative and/or coloured, metallurgical flux, lime and high-density concrete), 10 industrial mineral operations, 6 cement producer's quarries, 4 brick producer's quarries, 5 trap rock producers (one of which also produces the raw material for mineral wool and another produces wollastonite), and 2 gemstone and mineral specimen sites. All of Ontario's production of salt, gypsum, natural gas and petroleum, shale (for brick), lime/dolime, cement, nepheline syenite, high-purity calcium carbonate, and the majority of dimension stone, sand and gravel comes from the Southern Ontario Region.

For a detailed list of mining activity and locations of operating mines and mills in southern Ontario, please refer to Tables 2 and 3 and Figures 1 and 2. There are also many limestone aggregate quarries in operation that are too numerous to include in the list of mining activity.

New estimates for 2021 suggested that approximately 9600 people were directly employed in mineral extraction and on-site processing plants in southern Ontario. These figures do not consider the indirect jobs created by the mineral industry. In 2021, Ontario's non-metallic mineral production was valued at $2.1 billion—representing 18% of the total value of mineral production in the province. Five of the top 10 commodities (Table 1) produced in Ontario in 2021 were non-metallic minerals and most of this production came from southern Ontario mines and quarries. In 2021, approximately 16% of Ontario's total mineral wealth came from southern Ontario. This number is unchanged from 2020. Estimates for 2022 were not available at time of preparing this report (S. Jessome, Mineral Sector Analysis and Promotion Unit, Ministry of Mines (MINES), personal communication, January 2023).

Table 1 lists the top 10 commodities produced in Ontario in 2021.

Table 1. Ontario's top 10 commodities by value in 2021.

Number	Commodities	$ Millions
1	Gold	5784
2	Platinum Group Elements	1213
3	Copper	1018
4	Sand and Gravel	759
5	Nickel	758
6	Stone	638
7	Salt	288*
8	Nepheline Syenite	150
9	Clay Products	115*
10	Zinc	102*

** Estimated values (S. Jessome, Mineral Sector Analysis and Promotion Unit, MINES, written communication, January 2023).*

Wollastonite

CANADIAN WOLLASTONITE – ST. LAWRENCE DEPOSIT

Canadian Wollastonite (www.canadianwollastonite.com) is a privately held mining company incorporated in the province of Ontario. The company owns just over 220 ha of patent title property, encompassing a large portion of the St. Lawrence wollastonite deposit north of Kingston near the community of Seeley's Bay. The property straddles the boundary between the Township of Leeds and the Thousand Islands and the City of Kingston. Canadian Wollastonite produces about 20 000 t per year and has a total economic wollastonite resource of 30 Mt (B. Vasily, Canadian Wollastonite, personal communication, July 2022).

Canadian Wollastonite currently processes run-of-mine ore products that are sold into metallurgical, industrial, agricultural and environmental applications. The company has developed an effective beneficiation process for the extraction of high-aspect wollastonite and high-grade diopside products from the wollastonite ore. The company hopes to construct a beneficiation plant in the near future (B. Vasily, Canadian Wollastonite, personal communication, July 2022).

Adjacent orthogneiss is used in the production of Superpave™ aggregate in highway road construction and as class 1 and 2 railway ballast. The deposit is the southernmost approved source of Superpave™ aggregates in Ontario and is well situated to supply the eastern Ontario market. Recently, Canadian Wollastonite added decorative, landscape and dimension stone to its product line with unique and attractive stone for interior or exterior use (B. Vasily, Canadian Wollastonite, personal communication, July 2022).

Recent research on CO_2 sequestration by wollastonite demonstrates how wollastonite use in soil can be a regional-scale geoengineered CO_2 mitigation method (Haque, Santos and Chiang 2020; *see also* Canadian Wollastonite, www.canadianwollastonite.com/research/research-agricultural-uses/#A7). Canadian Wollastonite hopes the development of a quantitative method for determining and quantifying permanent CO_2 capture (inorganic carbon capture) from the use of wollastonite in soils, will allow the company to offer CO_2 credits through farmers (B. Vasily, Canadian Wollastonite, personal communication, July 2022).

Nepheline Syenite

COVIA HOLDINGS CORPORATION – BLUE MOUNTAIN MINE

Covia Corp. is an amalgamation of Unimin and Fairmount Santrol, and is privately owned by Belgium-based, SCR-Sibelco NV. Covia provides a diverse range of mineral solutions, such as nepheline, to several markets, including oil and gas, metals, glass, ceramics, foundry and construction.

Nepheline has been mined in the Havelock area for 85 years, with the Nephton Mine beginning in 1935 and Blue Mountain Mine in 1955. Unimin has operated the mine continuously since purchasing the site in 1989 and continues to operate Blue Mountain as part of Covia. The mine and plant operations currently employ approximately 200 workers.

Nepheline is used in the production of glass, ceramics, paint, fillers, insulation, abrasives and adhesives. It is used to lower the melting temperature of glass and ceramics, thus saving energy, extending the life of furnaces and reducing emissions. It also increases the quality and toughness of the glass, making it more resistant to breakage and reduces the need for volatile compounds (VOCs) in paint (Canadian Nepheline Modernization, https://canadiannepheline.ca/#canadian-nephaline).

In January 2018, Covia commenced the modernization and consolidation of their 2 nepheline processing plants located in southern Ontario into one larger state-of-the-art plant. The new Blue Mountain plant is designed to increase output capacity while reducing the site's environmental footprint, and to support continued mining, manufacturing and employment at the facility for many more decades. The majority of the work was completed in 2021, and the final equipment installed in 2022. The modernization will enable the optimization of new technologies and practices to reduce noise, dust, lighting, use of water and electricity (Covia Corp Media, www.coviacorp.com_2021esg-report).

The nepheline syenite deposit at Blue Mountain and Nephton strikes over 8 km with a width of 1.7 km. To date, the deposit has been defined to a depth of approximately 175 m and is open at depth. In 2020, the mine extracted approximately 113 Mt from the Nephton Mine, which translated into 535 239 t of nepheline syenite products. At current production rates, the mine reserves stand at 20 to 25 years, and the Inferred resources are estimated to last 60 years. The company conducts diamond-drill core exploration and test hole execution on a yearly basis to verify and refine the orebody model (A. Vanags, Covia Canada, written communication, January 2021).

The Blue Mountain Mine is considered a "world-class" deposit. It is the only nepheline syenite mine in North America and there are only 2 others in the world, located in Russia and Norway. In 2021, nepheline syenite was one of the top 10 commodities produced in Ontario (*see* Table 1).

Salt

Salt production began in Ontario in 1866. There are extensive beds of rock salt found in the Silurian Salina Group (formerly Salina Formation) rocks in parts of southwestern Ontario, west of London. Although there were numerous historical producers in southwestern Ontario, only a few produced more than 100 000 t of salt from brine well operations (Hewitt 1962).

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 operations, as warranted by the market demand. Provincial and municipal governments are the main market for de-icing salt.

In 2021, salt production in Ontario was valued at an estimated $288 million. Salt remains one of the top 10 minerals (*see* Table 1) produced in Ontario by value of production. Estimates for 2022 were not available at the time of preparing this report (S. Jessome, Mineral Sector Analysis and Promotion Unit, MINES, personal communication, January 2023).

Sifto Canada Corporation and the K+S Windsor Salt Ltd. each operate underground mines, brine fields operations and evaporation plants 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 and/or evaporation operations (Sangster et al. 2014).

SIFTO CANADA CORP. – GODERICH MINE AND EVAPORATION PLANT

Sifto Canada Corporation (www.siftocanada.com) is a subsidiary of the United States–listed public company, Compass Minerals International, Inc. (www.compassminerals.com) that trades on the New York Stock Exchange under the symbol CMP.

The Goderich salt mine, located 536 m under Lake Huron, employs around 400 people and is the largest underground salt mine in the world. It has operated since 1959, has produced over 150 Mt of salt (5.7 Mt in 2022) and has defined resources for an additional 72 years of production. The Goderich Mine's

updated closure plan was approved by the Ministry of Mines in 2021. Updated salt mineral resources and mineral reserves, include measured and indicated resources of 1469 Mt of salt, inferred resources of 134.4 Mt of salt and probable reserves of 420.3 Mt of salt (Compass Minerals International, Inc., Annual Report, January 2023). About 80% of production is used as road salt for communities around the Great Lakes and along the St. Lawrence Seaway. The remainder is trucked to the Compass Minerals plant less than 4 km away, to be packaged as refined salt for water softener or as sidewalk de-icing salt for distribution and sale at retailers in North America. The salt is also sold in bulk to manufacturers that make plastics, detergents, disinfectants and other important products (Compass Minerals, www.compassminerals.com *under* What We Do | How We Do It).

The Goderich plant has operated since 1867, after an unsuccessful search for oil uncovered a vast bed of rock salt under Goderich. Using mechanical evaporation, the plant produces high-purity, fine- and coarse-grained salt products in packages and in bulk for commercial, agricultural and industrial applications.

Since 2019, partner companies Hydrostor and NRStor have been operating a compressed air, energy storage facility at the Goderich Mine. An abandoned solution mine salt cavern at the site of the Sifto brine–table salt plant is used to store compressed air. The facility relies on the electricity price differential between times of low demand and high demand. During low-demand periods, the cavern is "charged" with compressed air and when demand is high, the air is released through turbines which generate electricity. The facility has a 2.2 megawatt charge rating, 1.75 megawatt peak power output, and more than 10 megawatt-hours of storage capacity (Hydrostor, www.hydrosor.ca/goderich-a-caes-facility), which is enough to keep the lights on in about 2000 homes, or approximately half the town of Goderich for about 5 hours (CBC News, "How an old Goderich salt mine could one day save you money on your hydro bill", news article, November 24, 2019, www.cbc.ca).

K+S WINDSOR SALT LIMITED – OJIBWAY MINE AND EVAPORATION PLANT

K+S Windsor Salt Limited (www.windsorsalt.com) is a subsidiary of Chicago-based Morton Salt (www.mortonsalt.com), which, in turn, is a subsidiary of K+S AG (www.k-plus-s.com), a global chemical company based in Germany and publicly traded on the Frankfurt Stock Exchange under the symbol SDF.

K+S Windsor Salt is the largest salt producer in Canada and extracts both rock salt from its underground Ojibway Mine and vacuum salt from its nearby brine evaporation plant in Windsor. In 2021, the Ojibway Mine employed 350 people and has been in operation since 1955 (CBC News, "Windsor Salt says supply for plant will run out in 5-10 years, will ask council to access reserves", news article, March 29, 2021, www.cbc.ca). The mine uses a traditional mining method of drill, blast and muck and is over 290 m beneath the city. The salt produced at the mine is sold as de-icing and industrial salts that are distributed throughout the Great Lakes region. The Windsor evaporation plant produces table salt, pool salt, water softeners and a wide range of products for industrial use. The facility has been in operation since 1928 and currently employs over 100 people (AM800, "Council Lends Support to Windsor Salt Expansion", news article, March 30, 2021, www.iheartradio.ca/am800).

In April 2022, Windsor city council approved K + S Windsor Salt access to municipally owned land to expand their salt reserves past the current 10-year timeline (CBC News, "Councillors vote in favour of helping Windsor Salt expansion plans", news article, March 30, 2021, www.cbc.ca).

Gypsum

CGC INC. – HAGERSVILLE MINE

CGC Inc., a subsidiary of United States–based USG Corporation, is an industry-leading manufacturer of building products and innovative solutions, including products for walls, ceiling, flooring, sheathing and roofing.

CGC Inc. (www.usg.com) runs a fully integrated operation in Hagersville, Ontario, transforming the raw product of its mine, on-site into gypsum wallboard and shipping directly from the site by rail throughout Canada. Gypsum mined in Hagersville also replaces, in part, synthetic gypsum that is currently imported from the US for use in CGC's wallboard plants.

Production of gypsum in Hagersville started in the early 1930s and reserves are sufficient for another 40 or so years of mining. The gypsum bed mined by CGC ranges in thickness from 0.8 to 1.2 m at approximately 30 m depth. The mine is accessed through a vertical shaft, and a decline that allows ore to be brought out on conveyor to an on-site wallboard plant. In 2021 the operations employed about 350 people (*Norfolk and Tillsonburg News*, "Partial closure at gypsum mine, plant at Hagersville", news article, May 3, 2021, www.norfolkandtillsonburgnews.com).

Brick and Shale

In 2022, there were 2 companies operating clay brick or tile plants and a total of 4 shale quarries in southwestern Ontario, all of which extract Queenston Formation shale as raw material. In 2021, clay was in the top 10 commodities produced in Ontario (*see* Table 1). The total value of clay products manufactured in Ontario in 2021 was estimated at $115 million, down from $123 million in 2020. Estimates for 2022 were not available at the time of preparing this report (S. Jessome, Mineral Sector Analysis and Promotion Unit, MINES, personal communication, January 2023).

CANADA BRICK

Canada Brick was created in October 2021 through the purchase of Meridian Brick Ltd. by General Shale (Canada Brick, https://canadabrick.com/about-us). Canada Brick operates 2 brick plants in Burlington and 1 plant in Aldershot, with shale quarries located at Niagara-on-the-Lake, Burlington and Aldershot. The company is Canada's largest brick manufacturer, accounting for about 55% of Canada's total brick production. Canada Brick employs up to 500 people at its 3 clay brick plants and 3 quarries in Burlington, with seasonal variations (Canada Brick, https://ca.linkedin.com/company/canada-brick).

The company owns the Aldershot, Burlington and Tansley quarries near Burlington, permitted for annual extraction of 999 999 t, 195 000 t and 300 000 t, respectively. The company also owns the Niagara Quarry near Niagara-on-the-Lake, where permits allow for an annual extraction of 450 000 t (Ministry of Natural Resources and Forestry, www.ontario.ca/page/find-pits-and-quarries, select button "Use the interactive Pits and Quarries map").

General Shale is a subsidiary of Wienerberger Brick, which had initially purchased Meridian Brick Ltd. from Boral Ltd. in December 2020. Revenue from Meridian's North American operations exceeded US$800 million in the first 9 months of 2022 (Wienerberger AG, Update for the First Three Quarters of 2022, July 2022, www.wienerberger.com).

BRAMPTON BRICK LTD.

Brampton Brick Ltd. (www.bramptonbrick.com) operates North America's single largest clay brick plant in Brampton, with production capacity of 400 million units per year (Brampton Brick, https://bramptonbrick.com/en/about-us/manufacturing-process). In 2020, the plant employed about 68 people (Ontario Prospectors Association, *Ontario Mining and Exploration Directory and Resource Guide 2020*, https://gotothunderbay.ca/key-sectors/mining/mining-resources under "General Resources", expand "Mines & Minerals Exploration, Ontario 2020", select "Ontario Mining Directory 2020"). The company reported that revenues for the first 9 months of 2020 increased to $110 million compared to $109 million for the corresponding period in 2019, the result, in part, of a noticeable increase in the Canadian masonry markets (Brampton Brick Limited, "Brampton Brick Reports Results for the Third Quarter Ended September 30, 2020", news article, November 11, 2020, www.globenewswire.com).

The company is permitted to extract 540 000 t of Queenston Formation shale annually at its Cheltenham Quarry near Brampton. The company also owns the Hungry Hollow quarries near Lambton Shores, approximately 50 km northeast of Sarnia, where 2 small quarries are permitted for a combined 40 000 t of extraction (Ministry of Natural Resources and Forestry, www.ontario.ca/page/find-pits-and-quarries, select button "Use the interactive Pits and Quarries map").

Cement

There are 6 quarries and 6 modern processing plants in southern Ontario between Kingston in the southeast and St. Marys in the southwest. All plants are also operating quarries on site.

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 Mt per year.

ST. MARYS CEMENT CANADA INC. – ST. MARYS AND BOWMANVILLE

St. Marys Cement Inc. (www.stmaryscement.com) is a subsidiary of Votorantim Cimentos (www.votorantimcimentos.com), which is part of the Votorantim Group, a privately held, and one of the largest, industrial conglomerates in Latin America. St. Marys Cement operates limestone quarries and cement plants at Bowmanville and St. Marys. The company employs a total of 263 people at its Ontario facilities.

In April 2021, Votorantim combined St. Marys Cement Inc with McInnis Cement Inc (Cision Canada, "Votorantim Cimentos and CDPQ Close Transaction to Combine Cement Operations in North America", news article, April 30, 2021, CNW Group Home Page). St. Marys net revenue for cement in the first 9 months of 2022 was around $566 036 (Votorantim Cimentos, https://ri.votorantimcimentos.com.br/en/financial-information/financial-statements).

Votorantim reported a net revenue increase of 9% in North America for the first 9 months of 2022 ($2.5 billion) over the same period in 2021 ($1.8 billion). The increase was attributed to strong market demand and price increases (Votorantim Cimentos, https://ri.votorantimcimentos.com.br/en/financial-information/earnings-release).

LAFARGE CANADA INC. – BATH

Lafarge Canada Inc. (www.lafarge-na.com) is a subsidiary of Lafarge North America and is, in turn, a subsidiary of LafargeHolcim (www.lafargeholcim.com), an international manufacturer of building materials based in Switzerland, which trades on the Swiss Exchange under the symbol SIX. Lafarge operates a cement plant in Bath, near Kingston, where they employ 110 people (Ontario Prospectors Association, *Ontario Mining and Exploration Directory and Resource Guide 2022*, https://oma.on.ca/en/ontario-mining/Map.aspx, under map, use link "Source: 2022 Ontario Mining and Exploration Directory and Resource Guide", p.26) and produce 1.1 Mt of cement per year. Lafarge also operates 3 nearby quarries to supply the Bath cement plant, the most important of which is the Bath limestone quarry (on site with the cement plant). Two small, nearby quarries, located just west and northwest of Gananoque, also supply silica to the cement plant as needed.

In June 2022, Lafarge Canada announced the Bath plant is converting from producing general use cement to producing Holcim's OneCem, a low CO_2 Portland limestone cement. Since 2018, Lafarge Canada has been converting their general use cement plants across Ontario, Quebec and Nova Scotia, to OneCem production (Global Cement, "Lafarge Bath to switch to OneCem low CO_2 cement", news article, June 23, 2022, www.globalcement.com).

The company reported 9.1 Mt of cement were sold in North America in the first 6 months of 2022, a 9.6% increase as compared to the same period in 2021 (LafargeHolcim, Half-Year 2022 Report, July 2022, www.holcim.com). There are no public figures reported for the Bath site.

Lafarge and subsidiaries also operate over 100 quarries, pits and other operations in southern Ontario producing aggregate, concrete, cement and fly-ash cement.

CRH CANADA GROUP INC. – MISSISSAUGA AND COLBORNE

CRH Canada Group Inc. (www.crhcanada.com) is a subsidiary of CRH plc (www.crh.com), an international group of diversified building materials businesses headquartered in Dublin, Ireland, which trades on the Irish Stock Exchange under the symbol CRG, and on the London Stock Exchange and New York Stock Exchange under the symbol CRH. CRH Canada operates a cement plant and adjacent shale quarry in Mississauga. Limestone is supplied to this cement plant from the company's Ogden Point Quarry located on Lake Ontario at Colborne. These operations employ around 180 people.

CRH also operates 16 aggregate pits and quarries, 27 concrete plants, 4 "Redimix" plants and 7 asphalt plants in southern Ontario.

LEHIGH CEMENT COMPANY – PICTON

Lehigh Cement Company is a subsidiary of Lehigh Hanson Canada, which is part of Heidelberg Cement (www.heidelbergcement.com), a German multinational building materials company trading on the Frankfurt Stock Exchange under the symbol HEI. In September 2022, Lehigh Hanson Inc. announced parent company Heidelberg Cement, was transitioning to Heidelberg Materials and that Lehigh Hanson will follow suit early in 2023 (Heidelberg Materials, news release, September 20, 2022).

Lehigh Cement operates a limestone quarry and cement plant at Picton, 1 of 6 plants in North America operated by Lehigh. The plant and quarry have been in continuous operation since 1958. The north quarry, north of Highway 49 and accessed through a tunnel underneath the highway, opened in 1982. The quarry covers a total of 319 ha and is licenced for a maximum annual tonnage of 3.6 Mt (Ministry of Natural Resources and Forestry, www.ontario.ca/page/find-pits-and-quarries, select button "Use the interactive Pits and Quarries map").

The Picton Plant produces both Portland and Masonry cement. The plant is located along Lake Ontario and ships the majority of its production from the facility by company-owned ships. The company also ships bulk and packaged product by truck. The plant's market area is the Great Lakes region of Canada and the United States. As of 2017, the plant produces approximately 816 466 t of finished product and has the capacity to annually produce approximately 1.2 Mt of clinker and approximately 1.3 Mt of finished product (D. Wight, Lehigh Cement, personal communication, 2017).

FEDERAL WHITE CEMENT LTD. – WOODSTOCK

Federal White Cement Ltd. (www.federalwhitecement.com) is a privately held Canadian company based in Embro, Ontario. The company operates a specialized white architectural cement plant in Embro, near Woodstock, using limestone from its quarry in Zorra Township southwest of Woodstock. The company employs 50 to 60 people (Ontario Prospectors Association, *Ontario Mining and Exploration Directory and Resource Guide 2022*, https://oma.on.ca/en/ontario-mining/Map.aspx, under map, use link "Source: 2022 Ontario Mining and Exploration Directory and Resource Guide", p.26).

Table 2. Mining and quarrying activity in the Southeastern Ontario District in 2022 (keyed to Figure 1).

No.	Company/Individual (Mine Name)	Township(s) (Commodity)	Mining Activity
1	Aecon Construction and Materials Ltd.	Gloucester, Marmora, Cavendish (Dolomitic sandstone)	Dolomitic sandstone from the Ottawa Quarry in Gloucester Township is produced from the lower member of the March Formation (11 m thick) for use in pavement aggregate. Limestone aggregate is produced from the site of former Marmoraton iron mine in Marmora Township. Burgundy coloured granite and limestone are quarried for use as crushed stone aggregate and decorative stone in Cavendish Township.
2	A.L. Blair Construction Ltd. (St. Albert, Heemskerk, Sixth, Cinnamon, Christie, Duval, Martin, Embrun, Plumadore, and Maclean quarries)	Roxborough, Winchester, Charlottenburgh, Kenyon, Russell, Osnabruck, Finch and Mountain (Limestone, dolostone sandstone, shale)	A variety of stone is quarried from several locations in southeastern Ontario and is used for aggregates, armour stone, building stone and landscape stone.
3	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 and the Rose Quartz pit, which charge a fee for mineral collecting.
4	Canadian Wollastonite (St. Lawrence Mine)	Pittsburgh, Leeds (Wollastonite)	Wollastonite skarn rock is produced and marketed as an agricultural soil additive. Gabbro is also being quarried and used in Superpave™ aggregate.
5	C.D.R. Young Aggregates (Bass Lane Quarry)	Galway (Limestone)	Limestone is extracted for use as armour stone, flag stone, landscaping and decorative stone and aggregates.
6	C.H. Demill Holdings Inc. (Long's (Melrose) Quarry)	Tyendinaga (Limestone)	Limestone is produced for use as aggregates.
7	Coco Aggregates (A division of Coco Group)	Kingston, Ernestown, Loughborough, Lansdowne, Elizabethtown (Limestone)	Coco Group produce a variety of products from aggregates to cement to asphalt. Coco Group owns 12 quarries located throughout eastern Ontario including Green Valley, Kemptville, Brockville, Iroquois, Napanee and Verona. Under Cruickshank Construction Ltd., the Elginburg Quarry near Kingston produces 500 000 t of limestone annually. Stone from the quarries has been used in shoreline protection projects along the St. Lawrence Seaway, including a $3.5 million breakwater and a marina project in Prescott.
8	Coloured Aggregates Inc. (Simpson Lake Quarry)	Ashby (Marble)	White, dolomitic marble is quarried and shipped to Coloured Aggregates plant in Marmora for the production of specialty aggregate.

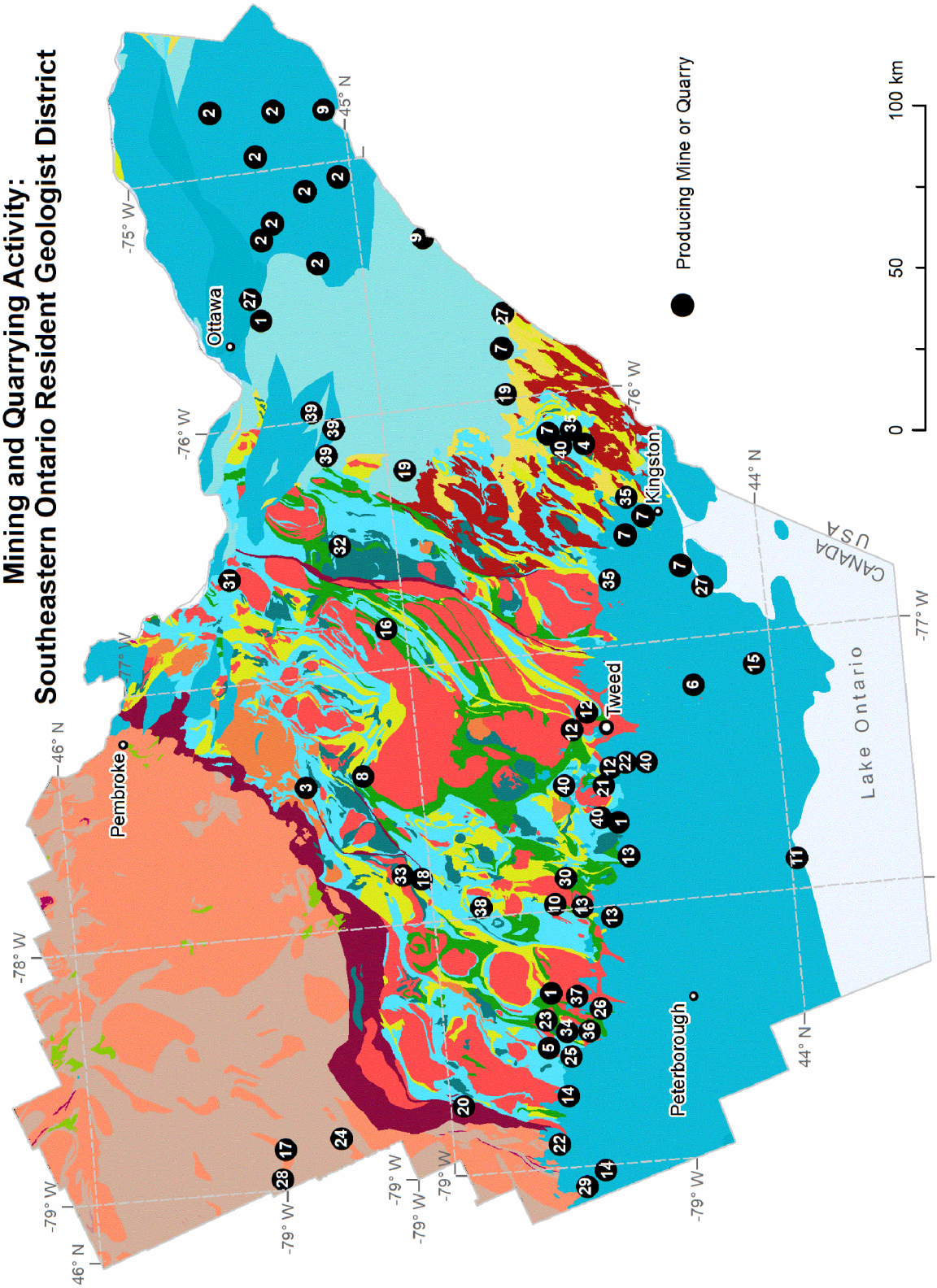

Figure 1. Mining and quarrying activity in the Southeastern Ontario District in 2022 (keyed to Table 2). Geology *from* Ontario Geological Survey (2011).

Table 2, continued.

No.	Company/Individual (Mine Name)	Township(s) (Commodity)	Mining Activity
9	Cornwall Gravel Co. Ltd. (Iroquois, McLeod 1 and McLeod 2 quarries)	Matilda, Cornwall (Limestone, cement)	Limestone is extracted to produce aggregates and ready-mix cement.
10	Covia Holdings Corporation (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.
11	CRH Canada Group Inc. (Ogden Point Quarry)	Cramahe (Limestone, cement)	CRH Canada has several quarries throughout Southern Ontario. The Ogden 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.
12	Danford Construction Ltd. (Francis Quarry, Blackwater Trap Rock Mine, Highway 7 Granite Quarry)	Huntingdon, Elzevir, Hungerford (Limestone, granite-gneiss, trap rock)	Limestone, granite-gneiss and trap rock are extracted for use as landscape stone, armour stone and a variety of high-quality MTO-approved aggregate products.
13	Drain Bros. Excavating Inc. (Havelock Quarry)	Belmont, Dummer, Methuen (Basalt, limestone, granite)	Basalt is extracted for use as trap rock from the Havelock Quarry in Belmont Township. Limestone and granite are quarried for aggregate in Dummer and Methuen townships, respectively.
14	Dufferin Aggregates (A division of CRH Canada Corp.)	Carden, Somerville (Limestone)	Grey limestone is extracted for use as armour stone, landscaping stone and crushed stone.
15	Lehigh Cement (Heidelberg Cement Group (Picton Quarry)	Sophiasburg (Cement)	A cement plant and on-site limestone quarry with an annual production of slightly less than 1 Mt. This is one of the largest cement plants in North America and employs 136 people.
16	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.
17	Fraser Quarry	Finlayson (Gneiss)	Predominantly pink gneiss is extracted for landscaping and other decorative applications.
18	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".
19	G. Tackaberry and Sons Construction Co. Ltd. (Lawson, Perth East and Pert West quarries)	Yonge, Drummond (Dolostone, sandstone)	G. Tackaberry and Sons own 50 pits and quarries throughout eastern Ontario. Dolostone and sandstone are extracted to produce armour stone, flag stone, ornamental stone, and aggregates.
20	Haliburton Stone Works	Minden (Granite, dolomite and limestone)	A variety of granite and limestone dimensional and landscape stones produced from 2 quarries.
21	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.
22	JC Rock (Laxton Quarry, Crookston Quarry)	Laxton, Huntingdon (Limestone)	Limestones from the Laxton and Crookston quarries are a natural grey or charcoal grey with warm earthy undertones. Both quarries supply the landscape design industry and the erosion control industry. The quarried stone is used as armour stone, curbstone, rock cubes and steps. The limestone has been used for historic building restoration in the Belleville area through to the Port Dalhousie Harbour breakwater.
23	Jeff Parnell Contracting Limited	Galway (Limestone)	Natural and dimension-cut armour stone, rockery stone, garden stone, natural surface steps and natural and dimensional flagstone.
24	John Bacher Construction Limited	McClintock (Granite, gneiss)	Building stone, flagging stone, and landscaping stone.
25	Johnston Quarry	Galway (Limestone)	Gull River Formation limestone is quarried for use as landscaping stone, flagstone and building stone.

No.	Company/Individual (Mine Name)	Township(s) (Commodity)	Mining Activity
26	Kawartha Rock Quarry Inc.	Harvey (Limestone)	Limestone is quarried to produce armour stone and flagstone.
27	Lafarge Canada Inc. (Bath, Brockville, Bearbrook and Hawthorne Quarries)	Ernestown, Elizabethtown, Gloucester (Cement, dolomitic sandstone, limestone)	In Ernestown Township, the company operates 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 Township as well as from recycled foundry sands. In Elizabethtown Township, 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. Limestone of lower member Gull River Formation, upper member Bobcaygeon Formation and the lower member of the March Formation (11 m thick) is quarried for use as high-quality aggregate in Gloucester Township.
28	McDonald Quarry	Finlayson (Gneiss)	Flagstone, building stone, armour stone
29	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.
30	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.
31	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.
32	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 227 000 t and quarry reserves currently stand at over 5 Mt.
33	Princess Sodalite Mine	Dungannon (Sodalite)	Decorative stone, landscaping stone, mineral specimens. There is a fee for mineral collecting.
34	Redstone Quarries	Galway, (Limestone, sandstone)	Beige limestone and red sandstone are quarried for weathered landscaping stone and armour stone blocks.
35	Rideauview Contracts Ltd. (Ellisville, McCallum, Petworth, Rideauview, Sloan and Battersea quarries)	Leeds, Kingston, Portland (Sandstone, limestone, granite)	Sandstone is produced for flagstone, granite blocks and masonry stone from the Ellisville Quarry in Rear of Leeds & Lansdowne Township. Limestone from the McCallum and Petworth quarries (in Storrington and Portland townships, respectively) is quarried for building restoration and new construction. In Storrington Township, red and cream sandstone are quarried for the production of ashlar, flagstone and landscaping stone at the Rideauview and Sloan quarries and red granite is quarried at the Battersea Quarry.
36	Rogue Stone (Bobcaygeon (Johnston Farm) Quarry)	Harvey (Limestone)	Dimension and Landscape stone consisting of beige to grey and red limestone is extracted from the Gull River Formation and the transitional section to the Shadow Lake Formation. The stone is used as natural armour stone, steps, flagstone and building stone.
37	Stonescape Quarry	Harvey (Limestone)	Limestone flagstone and ledgerock are quarried north of Buckhorn.
38	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
39	Thomas Cavanagh Construction Ltd. (Wilson, Goulbourn, Appleton quarries)	Beckwith, Goulbourn, Ramsay (Limestone)	Limestone is quarried to produce landscape material, aggregates and ready-mix concrete.
40	Upper Canada Stone Co. Ltd. (Pink Marble, Royal Green Marble, Madoc White Marble, Medium Buff Marble, Black Marble, Blue-Grey Marble, Light-Buff Marble and Kingston Red Granite quarries)	Madoc, Huntingdon, Marmora, Leeds (Marble, granite)	In Madoc, Huntingdon and Marmora townships, several colours of fine-grained marble are quarried for use as landscaping stone, dimension stone, terrazzo and decorative aggregate. In Rear of Leeds and Lansdowne Township, red granite is produced for precast concrete panels, pavers, split block, spun concrete poles and landscaping.

Table 3. Mining and quarrying activities in the Southwestern Ontario District* in 2022 (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	Arriscraft International Inc. (Thompson-Gatis and Crow Quarries)	Albemarle (Dolostone)	Dolostone and limestone are produced for use as architectural stone.
3	Attia Quarries (Rama and Seabright Quarries)	Rama (Dolostone)	Stone is quarried for use as landscaping, dimension, flag and masonry stone.
4	Block and Stone Resource Group Inc.	Amabel (Dolostone)	Dolostone is quarried for use as dimension stone.
5	Brampton Brick Ltd. (Cheltenham and Hungry Hollow North Quarries)	Chinguacousy, Williams (Shale)	Queenston Formation shale is extracted for use in the company's brick plant.
6	Bruce Peninsula Stone Ltd. (Lindsay, Wiarton and Mar Quarries)	Lindsay, Amabel, Albemarle (Dolostone)	Dolostone is produced for landscaping and building stone products.
7	Canada Brick (Meridian Brick Ltd.) (Aldershot, Burlington and Niagara-on-the-Lake Quarries)	East Flamborough, Niagara (Shale)	Queenston Formation shale is extracted for use in the company's brick plant. Meridian Brick Ltd. has recently been purchased by General Shale and rebranded as Canada Brick.
8	Carmeuse Lime Canada Ltd. (Beachville Quarry)	Zorra (Limestone)	Limestone is extracted, crushed and processed in on-site lime plant.
9	CGC Inc. (Hagersville Mine)	Oneida (Gypsum)	An on-site wallboard plant utilizes gypsum from the mine.
10	Coco Aggregates (A division of Coco Group)	Wainfleet, Mara (Limestone)	Coco Group purchased Cruickshank Construction in 2018. Coco Group produce a variety of products from aggregates to cement to asphalt. From the purchase, Coco Group acquired 12 quarries located throughout eastern Ontario including Green Valley, Kemptville, Brockville, Iroquois, Napanee and Verona. Under Cruickshank Construction Ltd., the Elginburg Quarry near Kingston produced 500 000 t of limestone annually. Stone from the quarries has been used in shoreline protection projects along the St. Lawrence Seaway, including a $3.5 million breakwater and a marina project in Prescott.
11	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 operation. Most production is distributed via Great Lakes shipping.
12	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).
13	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.
14	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.
15	Dufferin Aggregates (Flamborough Quarry)	Orillia, Esquesing, West Flamborough (Dolostone)	Dolostone is produced for use as armour, landscaping and crushed stone.
16	E.C. King Contracting Ltd. (Sydenham Quarry)	Sydenham (Dolostone)	High-purity dolostone is crushed for construction aggregate and agricultural lime.
17	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.
18	Elite Stone Quarries Ltd	Orillia (Limestone)	Limestone is quarried for use as armour stone.
19	Fowler Construction Company Limited (Fleming Quarry)	Rama (Gneiss)	Granitic gneiss is quarried for use as flagstone, building, landscaping, masonry and crushed stone.
20	Georgian Bay Marble and Stone (Cook Quarry)	Amabel (Dolostone)	Dolostone is produced for use as landscaping stone, steps and building stone.

No.	Company/Individual (Mine or Quarry Name)	Township(s) (Commodity)	Mining Activity
21	Hilltop Stone and Supply Inc. (Hilltop Quarry)	Esquesing (Sandstone)	Grey and buff sandstone is quarried for use as flagstone, masonry stone and dimension stone.
22	Hope Bay Quarry Inc.	Albemarle (Dolostone)	Dolostone is produced for use as flagstone, aggregate and armour stone.
23	Lafarge Canada Inc. (Dundas and Woodstock Quarries)	West Flamborough, Zorra (Dolostone, Limestone)	Dolostone is crushed for use as high-quality aggregate and steel making flux. Limestone is extracted and crushed for aggregate from a quarry near the site of a former cement plant.
24	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.
25	Ontario Limestone Company Ltd. (Rockleith Quarry)	Orillia (Limestone, dolostone)	Beige, tan and blue-gold limestone and dolomitic limestone is produced for use as dimensional building stone.
26	Owen Sound Ledgerock Ltd. (Owen Sound, Senesun and Wiarton Quarries)	Keppel, Amabel (Dolostone)	Dolostone is produced for use as custom cut and architectural cut stone, masonry, ledgerock, wallstone, marble tiles and slabs and landscape stone.
27	Rice and McHarg Ltd. (Rice and McHarg Quarry)	Esquesing (Sandstone)	Grey and buff sandstone is produced for use as flagstone, masonry and landscaping stone.
28	Rogue Stone (Orillia (Speiran) Quarry)	Rama (Limestone)	Dimension and Landscape stone consisting of light grey to white, micritic limestone and beige weathering dolostone is extracted from the Gull River Formation. The stone is used as natural armour stone, steps, flagstone and building stone.
29	St. Marys Cement Inc. (Bowmanville and St. Marys Quarries)	Darlington, Blanshard (Limestone)	Limestone is quarried and processed at cement plant complexes in Bowmanville and St. Marys.
30	K+S Windsor Salt Ltd. (Ojibway Mine and brine fields)	Sandwich (Salt, salt in brine)	Underground workings are adjacent to the international border. The company also produces salt from an adjacent brine field operation. In 2022, the company received approval from the City of Windsor to expand the mine and increase the mine life past the current 10-year timeline.
31	Walker Aggregates	Thorold, Bertie, Clinton, Grimsby, Malden, Colchester, Nottawasaga, Orillia, Keppel, Lindsay (Limestone, dolostone, granite)	Limestone, dolostone and granite are quarried for use as aggregates. Crushed limestone is use in asphalt, concrete, road construction, landscaping and lime for agricultural use.
32	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 2022, please refer to the report of the Petroleum Operations Section (this volume).*

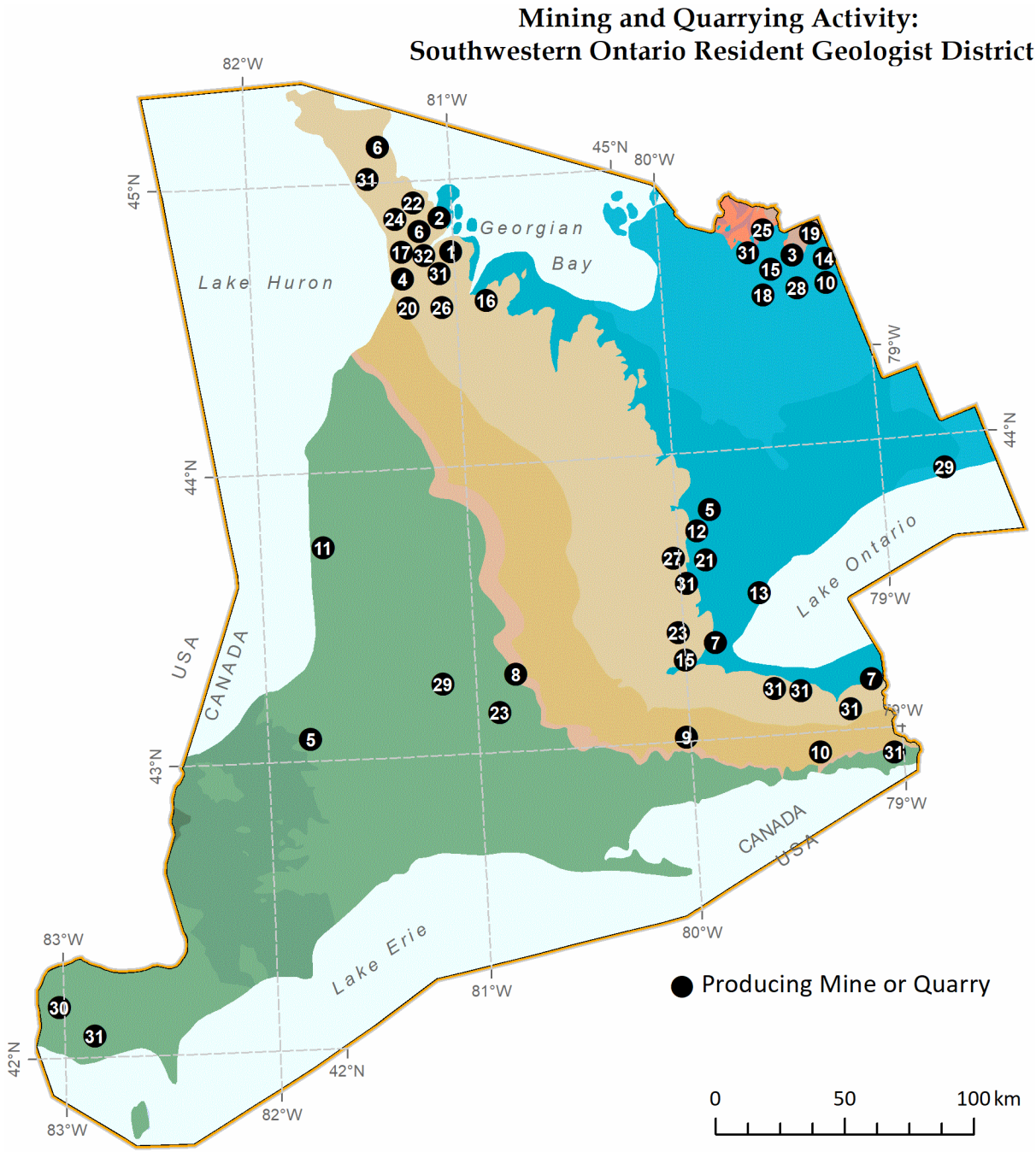

Figure 2. Mining and quarrying activity in the Southwestern Ontario District in 2022 (keyed to Table 3). Geology *from* Ontario Geological Survey (2011).

Dimension and Building Stone

Almost all of southern Ontario's dimension stone production comes from Cambrian and Paleozoic strata. Individual producers are listed in Tables 1 and 2 and the main centres of production are described below.

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 2022, 16 quarries in the County of Bruce and 3 quarries in the neighbouring County of Grey produce dimension stone under the *Aggregate Resources Act* for building, landscaping and flagstone markets. Several other quarries in both counties produce dolostone aggregate and can provide armour stone on demand.

The majority of the quarries in this area are within the Eramosa Member of the Middle Silurian Amabel Formation, which is a grey brown to black, laminated dolostone interbedded with light brown, thin to thick-bedded dolostone. The stone is sufficiently hard to take a good polish and, although not technically a marble, is often referred to as "Eramosa Marble" in the dimension-stone trade (Rowell 2015).

Rowell (2012) identifies provincially significant bedrock resources in the County of Bruce and provides details of national and provincial parks, and physical, cultural and environmental constraints on development, including the Niagara Escarpment Plan, which limit development of resources within that area for dimension stone and aggregate.

ORILLIA AREA QUARRIES

In Rama Township near Orillia, 8 companies operate dimension-stone quarries in limestone of the Paleozoic 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. 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 (Parks 1912) in Toronto, Peterborough and Orillia (Canada's Historic Places, www.historicplaces.ca *under* More | Featured Articles | Conservation, Rehabilitation and Sustainability | Rehabilitation of Historic Places; Rehabilitation of Toronto's Historic Places).

PETERBOROUGH AREA QUARRIES

There has been a long history of dimension-stone production in the Peterborough area. In 2022, 7 companies operated 8 dimension-stone quarries in the Peterborough area.

In 4 of the quarries, limestone of the Paleozoic Gull River Formation is extracted for a variety of applications, including landscape, masonry and armour stone. Thick-bedded limestone of the overlying Bobcaygeon Formation is also quarried and used primarily as aggregate and armour stone. The Parnell Quarry in Galway Township is located on a contact between Paleozoic sedimentary rock and Proterozoic metamorphic rock of the Canadian Shield. In addition to Gull River Formation limestone, dolostone and deep red ("wine") granite have been quarried at this site. A blue-grey interlayered marble-amphibolite unit is quarried at the Pluard Quarry in Chandos Township.

ROGUE RESOURCES – ORILLIA AND BOBCAYGEON QUARRIES

Rogue Resources (www.rogueresources.ca) owns the Orillia Quarry in Rama Township and the Bobcaygeon Quarry in Harvey Township. Both quarries are currently licenced for 20 000 t of stone per year. The quarries produce armour stone, step and flagstone from individual limestone beds ranging in thickness from under 2.5 cm to 71 cm.

The Orillia Quarry is located in the Gull River Formation near the contact between the Paleozoic sedimentary rocks and metamorphic rocks of the Grenville Province. The Gull River consists of light grey to brown, very fine-grained limestone and a greenish grey to tan dolostone (Rogue Resources, www.rogueresources.ca *under* About | Orillia Quarry).

The Bobcaygeon Quarry is also situated near the contact between the Paleozoic sedimentary rocks and metamorphic rocks of the Grenville Province. Dimension and landscape stone consisting of beige to grey, and red limestone are extracted from the Gull River Formation and the transitional section to the Shadow Lake Formation. The lowermost limestone units have a pink to reddish hue proximal to the underlying metamorphic rocks (Rogue Resources, www.rogueresources.ca *under* About | Bobcaygeon Quarry).

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 (Rideau Canal National Historic Site, www.rideauinfo.com). Kingston limestone, the 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, 25 km northwest of Kingston, and the McCallum Quarry, 10 km northeast of Kingston on the Battersea Road. Stone from Rideauview quarries have been used in several restoration projects in Kingston including Fort Henry City Hall and Queens University (Rideauview Contracts, http://www.rideauviewcontracts.com/pages/restoration.html).

SANDSTONE QUARRIES

Sandstone of the Whirlpool Formation (Lower Devonian) has been quarried in the Brampton area since 1840. Locally known as Credit Valley stone, it was used in the construction of many notable projects in Toronto, including Old City Hall, the Ontario Legislature (Queen's Park), pillars at Union Station, and the Timothy Eaton Memorial Church.

Three quarries continue to produce sandstone in the Brampton area. Credit Valley Sandstone Company and Hilltop Stone and Supply Inc. produce sandstone for new projects and for the restoration of many historic sandstone buildings in the Greater Toronto Area (Canada's Historic Places, www.historicplaces.ca under More | Featured Articles | Conservation, Rehabilitation and Sustainability | Rehabilitation of Historic Places; Rehabilitation of Toronto's Historic Places). Rice and McHarg Ltd. produce sandstone for landscaping and masonry. Products include split-face ashlar, flagstone, random wall stone and landscaping stone.

In southeastern Ontario near Kingston, Nepean Formation (Cambrian) sandstone is quarried by Rideauview Contracts Ltd. 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, including the Parliament Buildings in Ottawa and the restoration of locks on the Rideau Canal (Rideauview Contracts, www.rideauviewcontracts.com/pages/restoration.html).

Trap Rock

There are 5 companies operating trap rock quarries in southeastern Ontario, 4 located near Highway 7 between Peterborough and Tweed and 1 at Seeley's Bay, north of Kingston. Products include roofing granules, high-performance aggregate, railway ballast, and raw material for mineral wool production.

DRAIN BROS. EXCAVATING LTD.

Drain Bros. Excavating operates quarries near Havelock that produce metabasalt for use as railway ballast, filter stone, high-performance aggregate, roofing granules and mineral wool raw material. The company has on-site crushing facilities.

MRT AGGREGATES INC.

MRT Aggregates 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.

I.K.O. INDUSTRIES LTD.

I.K.O Industries 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.

Danford Granite 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 has been developed as a source of raw material for mineral wool manufacturing by Rockwool Group (formerly Roxul Inc.) in Milton. The company also operates several bedrock aggregate quarries in eastern Ontario.

CANADIAN WOLLASTONITE

Canadian Wollastonite produces trap rock from a body of mafic orthogneiss that is in contact with the wollastonite-bearing skarn of the St. Lawrence wollastonite mine at Seeley's Bay. The material has been approved by the Ministry of Transportation for use as a high-strength, high-friction surface aggregate in major highway construction. The stone is also suitable for use in high-strength concrete, as railway ballast, and as rip-rap and gabion stone (Canadian Wollastonite, www.canadianwollastonite.com/applications).

Calcium Carbonate (Marble)

OMYA CANADA INC. – TATLOCK QUARRY

Omya Canada Inc. (www.omya.com) is a subsidiary of Omya AG, a privately held global producer of industrial minerals headquartered in Switzerland. Worldwide, Omya AG produces mainly fillers and pigments derived from calcium carbonate and dolomite. Omya AG is also a worldwide distributor of specialty chemicals. The company extracts white calcitic marble from a high-purity zone at the Tatlock

Quarry in Darling Township. The marble is shipped to the company's processing plant in Perth for production of ground calcium carbonate products that are used primarily in the paint, paper and plastic industries. The Tatlock Quarry is permitted for a maximum annual extraction of 4 Mt. The Perth plant has recently been expanded and is easily accessed via the St Lawrence Seaway corridor (OMYA, www.omya.com/locations).

Historical Mineral Production – Southeastern Ontario District

Tables 4 through 7 list inactive historical producing mines with tons milled, ounces produced or total production, and the years of operation. The abbreviation "OMI" in the table headings, refers to the Ontario Mineral Inventory (Ontario Geological Survey 2022a).

Table 4. Historical production of copper, lead, zinc – Southeastern Ontario District.

Mine	OMI Number	Township	Operating	Tons Milled	Production
Kingdon	MDI31F08NW00012	Fitzroy	1884–1885, 1914–1931	905 000	76 821 409 pounds Pb concentrate; 857 312 pounds Zn concentrate; 60 074 072 pounds Pb recovered
Long Lake	MDI31C10NW00016	Olden	1897–1925, 1973–1974	3442, not available	$41 550 ore value, 9467 tons Zn valued at $1 227 000
Eldorado Copper	MDI31C12SE00022	Madoc	1906	not available	234 000 pounds Cu matte containing 230 ounces Au, 182 ounces Ag, 109 000 pounds Cu
Hollandia Lead	MDI31C12NE00020	Madoc	1903–1906	not available	2 653 365 pounds Pb

Table 5. Historical production of fluorite – Southeastern Ontario District.

Mine	OMI Number	Township	Operating Years	Total Production (Tons)
Bailey	MDI31C06NW00003	Madoc	1907, 1916, 1917, 1944–1950	25 000
Blakely	MDI31C06NW00019	Huntingdon	1918–1920, 1928, 1941–1947	5026
Coe	MDI31C06NW00008	Huntingdon	1941–1942	114
Dwyer	MDI31E01SE00091	Cardiff	1918–1920, 1943, 1944	97
Herrington South	MDI31C05NE00009	Huntingdon	1917	13
Howard, Fred Hill	MDI31C06NW00014	Huntingdon	1918, 1920, 1929, 1940–1942, 1944	2500
Johnston	MDI31C06NW00013	Huntingdon	1943, 1944–1947, 1949	187
Keene	MDI31C06NW00004	Huntingdon	1918–1919, 1943, 1944, 1950	5000
Kilpatrick	MDI31C06NW00005	Huntingdon	1944, 1953–1959	11 566
Lee Junior	MDI31C05NE00008	Madoc	1917, 1940, 1943–1945	2000
Lee Senior	MDI31C05NE00006	Madoc	1916–1918, 1942, 1943	1600
McIlroy	MDI31C05NE00003	Madoc	1917–1918, 1923, 1944	540
Miller	MDI31C05NE00005	Madoc	1917–1919	460
Noyes	MDI31C06NW00011	Huntingdon	1917–1920, 1941–1943	25 000
Palmateer	MDI31C06NW00016	Huntingdon	1942	44
Perry	MDI31C06NW00009	Huntingdon	1915–1920, 1941–1943	8000
Perry Lake	MDI31C06NW00007	Huntingdon	1910, 1913, 1915, 1917, 1952, 1960	4000
Ponton	MDI31C05NE00004	Madoc	1929–1942	1500
Rogers	MDI31C06NW00018	Huntingdon	1909–1914, 1943–1951	45 000
Rooks	MDI31C12SE00003	Madoc	1916–1918	100
South Reynolds	MDI31C06NW00010	Huntingdon	1917–1918, 1943	100
Wallbridge and Herrington	MDI31C05NE00007	Madoc	1920–1922, 1941–1943	6600
William Reynolds	MDI31C12SE00002	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).

Table 6. Historical production of gold – Southeastern Ontario District.

Mine	OMI Number	Township	Operating Years	Tons Milled	Ounces of Gold Produced	Grade (ounces gold /ton)
Big Dipper	MDI31C14SE00144	Barrie	1907–1909	52	17	0.33
Cook	MDI31C12SE00024	Marmora	1901–1904	1483	289	0.26
Cordova	MDI31C12SW00005	Belmont	1892	120 670	22 774	0.19
Craig	MDI31C12NE00014	Tudor	1905–1906	1850	248	0.13
Deloro	MDI31C12SE00039	Marmora	1897–1902	39 143	10 360	0.26
Gatling 5 Acre	MDI31C12SE00028	Marmora	1900–1903	6114	2353	0.38
Gilmour	MDI31C13SE00017	Grimsthorpe	1909–1910	550	172	0.31
Golden Fleece	MDI31C11NE00010	Kaladar	1919–1922	unknown	480	unknown
Ledyard	MDI31C12SW00008	Belmont	1893–1894	55	13	0.24
Pearce	MDI31C12SE00033	Marmora	1893–1908	239	302	1.26
Richardson	MDI31C12SE00253	Madoc	1866–1868	unknown	75 – 100	0.408
Sophia	MDI31C11SW00028	Madoc	1896–1901	1800	110	0.06
Sovereign	MDI31C12SE00035	Marmora	1878 1892–1900	unknown 1962	970 370	unknown 0.19
Star of the East	MDI31C14SE00012	Barrie	1905–1907	976	134	0.14
			Total	**174 894**	**38 592**	

Table 7. Historical production of iron – Southeastern Ontario District.

Mine	OMI Number	Township	Operating Years	Tons Milled	Grade (% Fe)
Calabogie	MDI31F07SE00009	Bagot	1883–1901	10 000	26
Martel	MDI31F07SE00013	Bagot	pre-1890	2000	58.71
Williams (Black Bay)	MDI31F07SW00027	Bagot	1880–1890	25 000	51.89
Black Lake	MDI31C09SW00053	Bedford	1882–1884	4000	40
Glendower	MDI31C10SE00022	Bedford	1873–1895	50 000	50 – 60
Belmont (Ledyard)	MDI31C12SW00004	Belmont	1899–1900, 1911–1913	8433	51.2
Blairton	MDI31C05NW00026	Belmont	1820–1875	300 000	51.8
Playfair (Dalhousie)	MDI31C16NW00002	Dalhousie	1866–1871	11 100	57.6
Radnor	MDI31F06NE00017	Grattan	1901–1907	18 824	47.5
Eagle Lake (Blessington)	MDI31C10NE00009	Hinchinbrooke	1887–1891	700	65.55
Tomahawk (Mag-Iron)	MDI31C12NW00002	Lake	1947, 1950–1957	2096	50.9
Wilbur	MDI31F02SE00009	Lavant	pre-1900, 1907–1908	146 892	56.69
Paxton	MDI31D15SE00090	Lutterworth	pre-1910	1000	not available
Miller	MDI31C11SW00021	Madoc	1899	6823	not available
Wallbridge	MDI31C12SE00016	Madoc	1900–1901, 1919, 1921	3421	not available
Marmoraton	MDI31C05NE00014	Marmora	1952–1978	28 000 000	40
Bessemer	MDI31F04SE00012	Mayo	1902–1913	99 613	42.18
Childs	MDI31F04SE00013	Mayo	1913	9649	38.7
McNab	MDI31F08NW00004	McNab	1873–1874	15 000	68
Robertsville and Mary	MDI31C15NE00005	Palmerston	1895, 1900–1901, 1918–1909	13 477	70.5
Fournier	MDI31C16SW00009	South Sherbrooke	1873	600	60
Howland	MDI31D15SE00096	Snowdon	1880–1882	1500	58
Victoria	MDI31D15SE00098	Snowdon	1882	unknown	58.35
Dog Lake	MDI31C08NW00008	Storrington	1899	600	51.12
St. Charles	MDI31C13SE00014	Tudor	1900–1902	5186	57 – 60
Coe Hill	MDI31C13SW00010	Wollaston	1884–1914	100 000	51.4
			Total	**28 841 914**	

EXPLORATION ACTIVITY

In 2022, there were 483 claims registered electronically in southern Ontario, up from 2021, when 294 claims were recorded. This brings the total active claims to 4128. The total area covered by claims in southern Ontario in 2022 was 98 674 ha (Figure 3; Table 8), a decrease of 703 ha from 2021. The total work approved in 2022 was $80 336. Figure 3 shows the claim staking activity for southern Ontario in 2022.

Table 8. Summary of claim status in the Southern Ontario Mining Division.

Year	Active (Cells and Claim Units)	Total Area Covered (Hectares)
2022	4185	98 674
2021	4489	99 377
2020	4419	97 777
2019		100 455
2018	6794	116 319

Mining claim registration in Ontario is done through the Mining Lands Administration System (MLAS) (www.ontario.ca/page/mining-lands-administration-system), which is an online self-service system that provides access to mining claim registration and land management.

Active exploration plans for Southern Ontario Region are listed in Table 9. Active exploration permits are in Table 10. Assessment files received for the Southern Ontario Region are listed in Table 11 and exploration activity is listed in Table 12. The locations of new claim registration are shown in Figure 3. Exploration projects, and exploration plans and permits are shown in Figure 4 (keyed to Tables 9 and 10). It should be noted that the number of assessment files received does not reflect the amount of exploration work that is carried out in the Southern Ontario Region. The reason is that the vast majority of exploration work carried out in southern Ontario is on private land where claim holders are not required to submit assessment work.

Exploration plans and permits are documents issued by the Ministry of Mines under the *Mining Act* for certain prescribed early mineral exploration activities. They are required for line cutting, geophysical surveys on the ground requiring the use of a generator, mechanized stripping, excavation of bedrock, and use of a mechanized drill.

Information on exploration plans and the submission process can be found at www.ontario.ca/page/exploration-plans. Information on exploration permits and the submission process can be found at www.ontario.ca/page/exploration-permits.

In 2022, most of the exploration activities and expenditures in the Southern Ontario Region were focussed on gold, graphite, rare earth elements and zinc as described below.

Use of the outdoor Drill Core Library in Tweed as an exploration tool has decreased in recent years, as funding has been lacking for major field exploration projects.

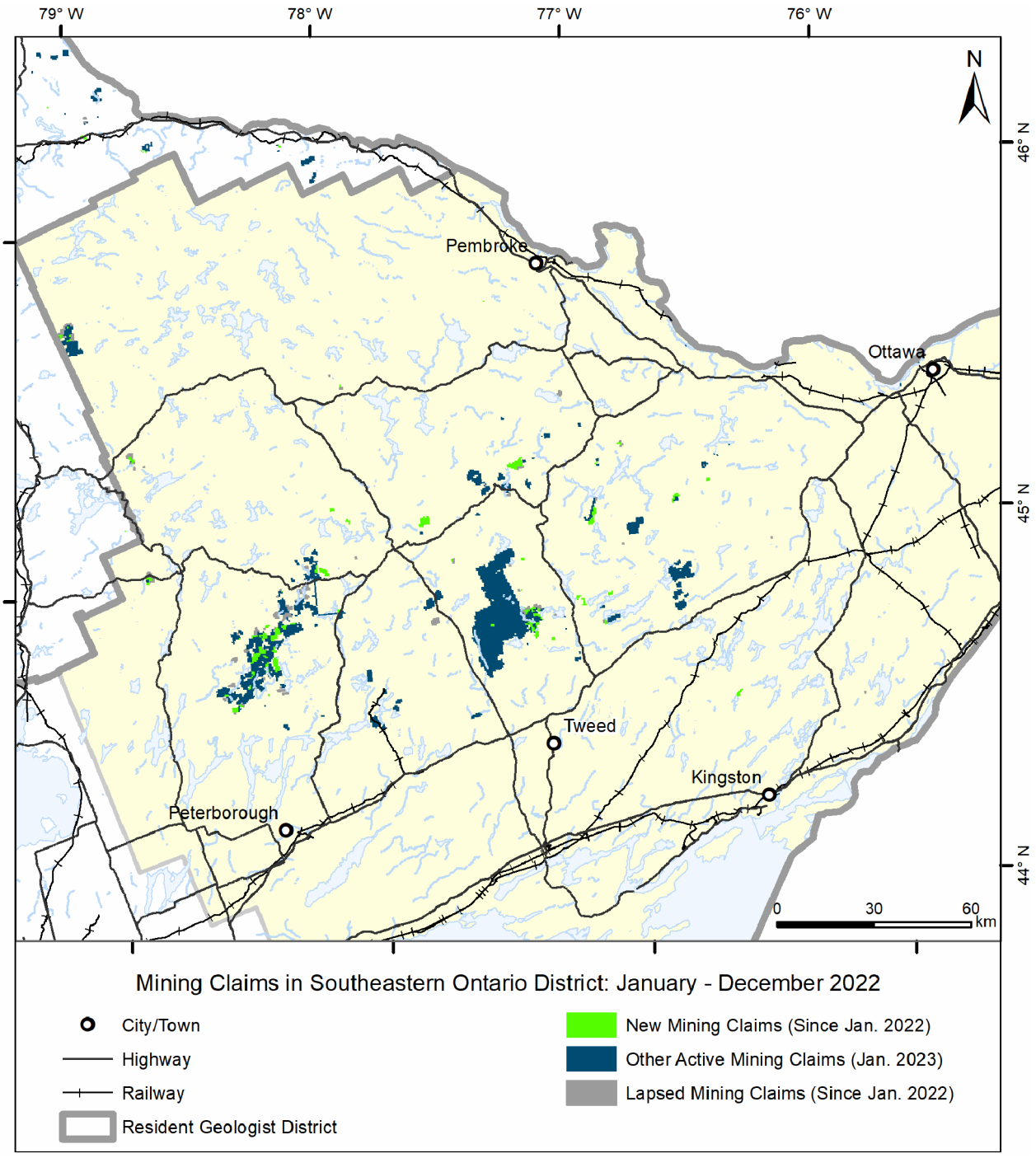

Figure 3. Location of Southeastern Ontario District showing active mining claims, including lapsed mining claims and new mining claims registered during 2022.

Table 9. Active exploration plans ("PL-") in the Southeastern Ontario District in 2022 (keyed to Figure 4).

No.	Plan No.	Plan Holder	Property Name	Township (Commodity)	Exploration Activity
1	PL-21-000010	R. Waring	Waring Creek East Gold	Anglesea	Mechanized Stripping; Pitting and Trenching of Bedrock
2	PL-22-000057	Skead Holdings Ltd.	Cardiff RE project	Cardiff	Mechanized Stripping

Table 10. Active exploration permits ("PR-") in the Southeastern Ontario District in 2022 (keyed to Figure 4).

No.	Permit No.	Permit Holder	Property Name	Township (Commodity)	Exploration Activity
1	PR-21-000059	R. Waring	Waring Minerals Lt zone	Anglesea	Airborne Geophysics; Mechanized Stripping; Pitting and Trenching of Bedrock
2	PR-21-000284	R. Waring	H. Dowhaluk shear zone	Anglesea	Mechanized Stripping Pitting and Trenching of Bedrock

Table 11. Assessment files received in the Southeastern Ontario District in 2022.

Abbreviations

ASSAY ..... Assaying and analyses
DHRSMP ..... Drill core resampling
ENVIRO ..... Environmental studies
INDUS ..... Industrial mineral testing and marketing
MCOMP ..... Miscellaneous compilation and interpretation
OPHYSI ..... Other physical
OTHER ..... Other
PROSP ..... Prospecting by licence holder
PSTRIP ..... Overburden stripping
ROCK ..... Rock sampling

Assessment File Number	Township	Company Name	Property	Year	Work Type	Work Approved	Other File ID*
20000019918	Anglesea	R. Waring	Waring Creek gold property	2019–2021	ASSAY, OPHYSI, PROSP, PSTRIP, ROCK	$15,980	4071, 72185
20000019938	Methuen	Trigan Resources Inc.	West Gabbro project	2021	ENVIRO	$11,300	4235, 75118
20000020028	Methuen	Trigan Resources Inc.	East Gabbro project	2021	ENVIRO	$2,400	4341, 76421
20000020125	Matawatchan, Miller	J. Martin, J. Andreana	Black Mountain project	2021	PROSP, ROCK	$2,488	4420, 77123
20000020159	Brougham, Matawatchan	J. Martin, J. Andreana	K9 project	2020–2021	ASSAY, INDUS, MCOMP, PROSP, ROCK	$6,742	4422, 77159
20000020129	Snowdon	Skead Holdings Ltd.	Snowdon property	2020–2022	ASSAY, DHRSMP	$6,382	4470, 77979
20000020360	Cardiff	Skead Holdings Ltd.	Cardiff RE project	2021	OTHER, PROSP, ROCK	$16,501	4302, 75784
20000020367	Grimsthorpe	R.J. Dillman	Black River South property	2021	ASSAY, PROSP, ROCK	$14,393	4438, 77409
20000020391	Monmouth	D.J. Ross	Claim 58257	2020–2021	PROSP	$2,344	4571, 79403
20000020394	Methuen	Covia Canada Ltd.	Blue Mountain nepheline mine	2021	ENVIRO	$13,105	4579, 79515

**Four-digit file identifiers represent Work Report numbers and five digit identifiers represent Mining Lands Administration System (MLAS) transaction numbers.*

Table 12. Exploration activity in the Southeastern Ontario District in 2022 (keyed to Figure 4).

Abbreviations

ASSAY ..... Assaying and analysis	RCALC ..... Reserve/resource calculations
BULK ..... Bulk sampling	RECON ..... Regional or reconnaissance ground exploration
INDUS ..... Industrial mineral testing and marketing	ROCK ..... Rock sampling
PROSP ..... Prospecting	TRPT ..... Technical report (NI 43-101)

No.	Company/Individual (Property Name)	Township/Area (Commodity)	Exploration Activity	Description
1	ESGold Corp. / Nepean Bay Joint Venture *(Ottawa River project)*	Nepean (Gold)	ASSAY, BULK, ROCK	ESGold Corp. (*formerly* Secova Metals Corp.) partnered with Nepean Bay Joint Venture to evaluate the value of the waste material on the riverbed of the Ottawa River adjacent to the Royal Canadian Mint. The company completed an underwater sampling program consisting of 61 samples (2 kg each) extracted by divers along 6 grid lines, along with 4 t of bulk sample material. Results ranged from trace Au to 1.872 g/t Au, and 1 crushed slag sample which returned 35.39 g/t Au.
2	J. Martin / J. Andreanna (*K9 graphite property)*	Brougham, Matawatchan (Graphite, marble)	PROSP, RECON, ROCK	J. Martin and J. Andreanna completed a reconnaissance program consisting of grassroots prospecting and rock sampling.
3	J. Martin / J. Andreanna *(Black Mountain property)*	Miller, Matawatchan (Graphite)	PROSP, INDUS, RECON, ROCK	J. Martin and J. Andreanna completed a reconnaissance program consisting of grassroots prospecting and rock sampling. The prospectors also completed industrial mineral testing.
4	N. Scott	Mayo (Graphite)	PROSP, ROCK	N. Scott completed a grassroots prospecting program.
5*	Sifto Canada Corp. / Compass Minerals International Inc. *(Goderich Mine)*	Goderich (Salt)	RCALC	Compass Minerals International Inc. (of which Sifto Canada is a subsidiary) released its 2021 annual fiscal report in January of 2022. This report provided updates on the Goderich salt mine, including updated production statistics and mineral reserves and resources.
6	Stratabound Minerals Corp. *(Dingman property)*	Marmora (Gold)	TRPT, RCALC	Stratabound Minerals Corp. (*formerly* California Gold Mining Inc.) announced it has filed an updated National Instrument 43-101 Technical Report on its Dingman property. The company also states in the press release that the project is not core to its assets and that interested parties are invited inquire regarding optioning or acquiring the Dingman project.

** **Note**: Location 5 is not included on Figure 4 (for location,* see *Figure 2, location 11).*

Exploration Projects

GOLD

ESGold – Ottawa River Project

ESGold Corp. (https://esgold.com), formerly Secova Metals Corp., is an exploration, mining and processing company that focusses on advanced gold and silver projects with several restoration and recovery projects in Quebec and Ontario. ESGold Corp. trades on the Canadian Stock Exchange under the symbol ESAU.

In June 2022, Secova entered into an option agreement with Nepean Joint Venture Inc. that legally owns a land use permit for 2.6 ha of the Ottawa River's bed at the site of the Royal Canadian Mint. In July 2022, Secova Metals Corp. announced the company's name change to ESGold Corp. (ESGold Corp, news release, July 11, 2022)

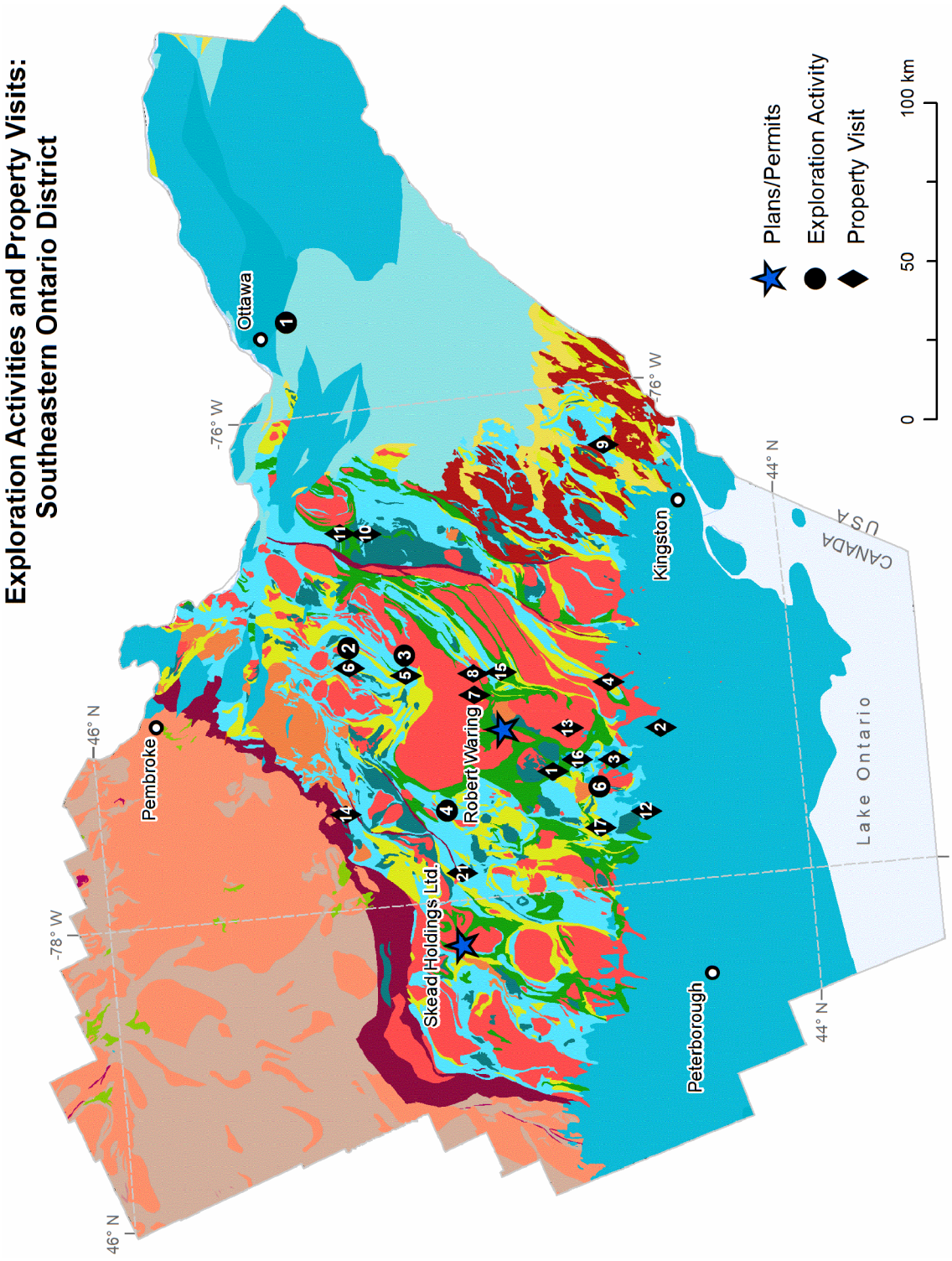

Figure 4. Exploration activity in the Southeastern Ontario District in 2022 (keyed to Tables 9, 10, 12 and 14). Sifto Canada' s annual report release (Table 12, No.5) is not included on the map. The locations for property visits (Table 14, No.18, 19 and 20) are also not included on the map. Geology *from* Ontario Geological Survey (2011).

The Royal Canadian Mint began minting coins in 1908, with gold added in 1911. From 1908 to 1975, precious metal lost during the refining process were washed into the Ottawa River through gravity fed drains (ESGold Corp, Ottawa River project, https://esgold.com). In 1975, new federal laws prohibited this practice leaving the precious metals to sit on the bottom of the Ottawa River for 47 years. ESGold holds authority and exclusive rights for exploration and recovery of gold, silver, copper, platinum and palladium lost from the Royal Canadian Mint over the 67-year period. Using historical records, ESGold estimated 4 million ounces of gold alone was lost to the river.

During the months of June and July of 2022, ESGold in partnership with Nepean Bay Joint Venture Inc. began phase 1 of a sampling program and bathymetry survey of the Ottawa River in front of the Royal Canadian Mint. They identified 2 priority areas and 3 high value targets as a result. They plan on starting phase 2 in the summer of 2023 (ESGold Corp, Ottawa River project, https://esgold.com).

Waring Minerals Inc. – Waring Creek Gold Property

Prospector R. Waring continued exploration of his gold prospects in the area of the Partridge Creek shear zone in western Anglesea and eastern Grimsthorpe townships (R. Waring, Waring Minerals Inc., written communication, September 2022).

Gold mineralization occurs in several locations on the property within sulphide-bearing, rusty, smoky quartz veins within sheared metavolcanic rocks, possibly associated with second-order structures along the Partridge Creek shear zone (Poulsen 2016). The focus of exploration to date has been the areas of the Main, North and South occurrences. Shallow-dipping, extensional quartz veins at the Main showing have assayed 20 g/t Au (Dowhaluk 1991) and 66 g/t Au (Waring 2016). Waring (2016) also reported assays of 13.3 g/t Au from the North showing and 1.38 g/t Au from the South showing. Also, of interest at the South showing is the presence of native bismuth in a quartz vein that assayed >10 000 ppm Bi (R. Waring, Waring Minerals Inc., personal communication, January 2019).

Mr. Waring's claims include the United Reef Petroleum Ltd. gold occurrence, approximately 2 km northwest of the area near the Partridge Creek shear zone. Previous work by Beesley (1999) on the United Reef property gave results of up to 4.5 g/t Au from a sericite-altered quartz porphyry with a stockwork of narrow quartz veinlets, and anomalous values of up to 0.27 g/t Au from a lean, siliceous iron formation. Gold mineralization associated with quartz veins in both the lean iron formation and quartz-feldspar porphyry was confirmed by the District Geologist in samples taken during a property visit in 2019.

In 2022, exploration on the Waring property consisted mainly of examining newly exposed areas that were the result of a large number of trees downed during severe weather events that occurred in southeastern Ontario. Several sulphide-bearing quartz veins up to 2 m wide were found in these newly exposed areas (R. Waring, Prospector, written communication, September 2022).

GRAPHITE

J. Martin and J. Andreana – Black Mountain Graphite Project

Prospectors J. Martin and J. Andreana continued exploration of their graphite project in Matawatchan and Miller townships.

The original claims were staked in 2016 based on new graphite occurrences discovered during mapping by the Ontario Geological Survey (Duguet, Duparc and Mayer 2015). After prospecting along strike to the south in March 2018 and confirming the presence of graphite, additional claims were added to the original group to cover a total of 9 km of strike length of the favourable, graphite-bearing units.

Ground magnetic and resistivity surveys were done in the northern part of the claim group in 2017. In 2018, several new graphite showings were identified within a belt of quartz-rich, arkosic metasedimentary rocks containing accessory pyrite, pyrrhotite, biotite, phlogopite, feldspar and garnet. The more sulphide-rich material commonly weathers to a gossan and was mapped by Duguet, Duparc and Mayer (2018) as "rusty schist" (*see* Duguet, Duparc and Mayer 2018: map unit 9g).

Graphitic schist with flake graphite content in the range of 2 to 3.5% has been identified over a strike length of about 7.5 km on the Black Mountain claim group. Preliminary prospecting indicates width of the zones is up to 30 m. Canada's largest past-producing graphite mine, the Black Donald Mine, is located 13 km along strike to the northeast from the Black Mountain property, where the deposit is associated with rusty, pyrite-pyrrhotite-graphite–bearing schists and calc-silicates near the contact with carbonate metasedimentary rocks, similar to the graphite mineralization on the Black Mountain property (Tessier et al. 2019, p.48-58).

In 2022, prospecting and rock sampling continued across the property, including new traverses that confirmed graphite mineralization in the central portion of the claims. The pair also worked with exploration companies and Queen's University in Kingston, Ontario, for testing of the mineralization and research on graphite liberation and potential processing techniques (J. Martin, Prospector, written communication, December 2022). A dark 0.3 m wide band within the graphite zone, that was previously unsampled and visually estimated to contain 10% graphite, was sampled by the District Geologist during a property visit in June 2022. The sample (22MDT-0007) was tested by infrared analysis at Activation Laboratories Ltd. (Ancaster) and returned 3.52% graphitic carbon.

The Black Mountain graphite property is currently available for option.

J. Martin and J. Andreana – K9 Area Claims

Prospectors J. Martin and J. Andreana continued exploration of the K9 graphite prospect in Matawatchan and Brougham townships.

The claims were registered based on mapping of the area in 2015 by the Ontario Geological Survey, because 12 samples collected by OGS staff were noted to contain graphite (Duguet 2018). Sampling over a strike length of 500 m suggests continuous flake graphite mineralization on a northeast strike (15° dip SE) with graphite grades of 1 to 5% and large flake size, up to 4 mm. The host rock is dominantly a coarse-grained calcitic marble, with metasedimentary units trending northeast in parallel nearby.

In 2022, exploration on the K9 graphite consisted of prospecting perpendicular to the graphite mineralization, and additional rock sampling. Samples collected by the prospectors were submitted to the Southern Ontario Regional Geologist and sent for analysis on their behalf. Two samples (JM-21-01 and JM-21-02) were sent to Activation Laboratories Ltd. (Ancaster) for graphitic carbon infrared analysis and mineralogy and grain-size analysis, respectively. Results confirmed the size and shape of the graphite flakes, as well as the high purity of the host calcitic marble (*see* "Property Examinations").

DISTRICT 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. In 2022, the office was staffed by L.A. Mancini, *P.Geo.*, Regional Resident Geologist; M. Dorado-Troughton, *G.I.T.*, District Geologist; P.S. LeBaron, *P.Eng.*, Regional Land Use Geologist – Southern Ontario; L. Beckering-Vinckers Stofer, GIS Data Specialist; N. Sabiri, District Geological Assistant (January through September) and GIS Data Specialist (September onwards); and L.M. Rodriguez Miguel, Geoscience Data Processor (October through December). Summer Experience Opportunity (SEO) student, H. Craig, provided field season support.

S.L.K. Hinz, Mineral Deposit Compilation Geoscientist – Northeastern Ontario, based remotely, contributes to updates and review of the District's data in the Ontario Mineral Inventory database. A detailed description of the activities of this position has been provided by S.L.K. Hinz and is included in this report. G. Dorland, GIS Data Specialist – Northwest Region, based in Thunder Bay, also contributes significantly to the RGP. Highlights of the work carried out by the GIS Data Specialists are also included in this report.

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 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 of Mines (MINES) Information and Lands Branch–Mining Lands Section front-counter client services and works with the MINES Indigenous Consultation and Partnerships Branch to assist in fostering relations between the mineral industry and Indigenous 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 by appointment.

Table 13 provides a five-year summary of program activity.

Special Projects

There are over 6500 mineral occurrences in southern Ontario documented in the Ontario Mineral Inventory (OMI) database (Ontario Geological Survey 2022a). Staff of the Southern Ontario Regional Resident Geologist's office work with the Mineral Deposit Compilation Geoscientist—Northeastern Ontario on an ongoing basis to ensure the integrity of the database. Site investigations to confirm the presence and accurate locations of OMI data entries are an essential part of the process. Wherever possible, OMI entries were updated as sites were visited, or created where necessary. The District Geologist updated approximately 17 OMI files and created 3 new files (*see* "Property Examinations").

The District Geological Assistant and District Geologist were involved in the implementation of upgrades to the Ontario Mineral Exploration Information System (OMEIS), which is an intranet-based data management system launched in 2018 that is used internally by RGP and Mining Lands staff to maintain and update assessment file and drill-hole data. The third phase of OMEIS was completed in 2021 and resulted in the integration of internal RGP databases and the Ontario Mineral Inventory (OMI) database to OMEIS. For more information on this update to OMEIS and the OMI, *see* "Mineral Deposit Compilation Geoscientist Activities" and "Geographic Information System Data Specialists Activities". Throughout 2022, the District Geological Assistant and District Geologist continued collaboration with the OMEIS working group on phase 3, assisting with updating OMEIS records for other RGP districts, and reviewing and preparing the Archives of the Resident Geologist Offices database for a future online launch. The District Geologist and H. Craig (summer student) began work on data entry for the Property Examination Geodatabase for Southern Ontario and the Northeast region.

Mineral Shows, Presentations, Outreach and Field Trips

Because of the public health restrictions that were implemented in response to the COVID-19 pandemic, staff attendance at public outings, such as mineral shows and conferences, were limited. Staff attended virtual meetings and conferences wherever possible.

In February 2022, office staff virtually attended the Regional-Scale Groundwater Geoscience in Southern Ontario Open House.

Also in February, the District Geologist virtually attended the AME Roundup Event. The Regional Resident Geologist virtually presented the RGP's Recommendations for Exploration at the AME Roundup Event and again in June at the Prospectors and Developers Association of Canada Convention.

In July, staff from the Tweed office presented a poster and sample display booth at the 4-day Bancroft Rockhound Gemboree and gave 3 presentations on the "Mines of Southern Ontario" and, in October, attended the Ancaster Gem, Mineral and Bead Show. The Resident Geologist again presented the "Mines of Southern Ontario" to the Niagara Peninsula Geological Society in October.

Also in October, the Ontario Geological Survey held the first OGS Virtual Showcase, during which the Resident Geologist presented "Exploration, Mining and Resident Geologist Program Activity Update for Southern Ontario". Many of the presentations are accessible online now, *see* "OGS Activities and Research By Others" for more details.

On October 28, the Regional Land Use Geologist and District Geologist led a tour of marble quarries in southeastern Ontario for a group of stone carvers and artisans.

In November 2022, the Regional Land Use Geologist and Resident Geologist hosted the Quinte Woodlot Association at the Tweed office as part of the association's goal to educate members on the role geology plays in the growth, health and quality of woodlands and other vegetation. The office visit included a presentation on the geological history of southern Ontario, mineral and map displays, and a discussion on the geology of the Tweed area.

Drill Core Storage Site

The Resident Geologist's Office maintains an off-site diamond-drill core storage compound on Hunt Road, approximately 2 km south of Tweed. In addition to core stored on traditional core racks, the site houses over 210 000 m of irreplaceable drill core from southern Ontario, of which about 157 000 m are stacked on pallets and 53 000 m are stored in racks. A smaller collection of core stored in both outdoor

and indoor racks is located at the Resident Geologist Office facility in Tweed. The state of the drill core varies and potential users of the drill core library are strongly encouraged to contact the Resident Geologist's Office ahead of their visit.

In 2022, staff of the Resident Geologist's Office provided access for K.E. Hahn, Paleozoic Geoscientist with the OGS Earth Resources and Geoscience Mapping Section (ERGMS), and field assistant to diamond-drill core from their map area (*see* "OGS Activities and Research By Others"). Staff also provided access to diamond-drill core for a consultant geologist for Crown William Mining Corp., who was studying historical drilling results on the Bannockburn gold property.

Brushing out and clearing debris from the off-site drill core storage area was done by an external contractor as part of an ongoing maintenance program.

Table 13. Program activity statistics (five-year summary) for the Southern Ontario Regional Resident Geologist's office.

Activity	2018	2019	2020	2021	2022
Field Investigations / Property Visits	52	23	0	4	23
Field Trips Given / Field Guides Written	10	4	0	0	2
OMI* Records Revised **	0	98	39	37	17
Clients Visits to RGP–Tweed Office***	182	102	27	7	121
Drill Core Library Users (person-days)	179	25	13	3	41
Client Communications (mail, email, phone)	>3000	>3000	>200	>300	>1300

**Ontario Geological Survey (2022a).*
***As a result of overhauls of the OMI system, during 2021, practically every record was revised, and system-wide data improvements are regularly applied. In 2021, records were updated before the OMI system changes. In 2022, revised records reflect substantial updates by the District Geologist. For more information,* see *"Mineral Deposit Compilation Geoscientist Activities—Northeastern Ontario".*
****2020 office visits occurred between January 2 and March 16, 2020, prior to the COVID-19 restrictions and office closure. 2021 office visits occurred when permitted with regards to COVID-19 restrictions and office closures.*

PROPERTY EXAMINATIONS

In 2022, a total of 21 properties in the Southern Ontario Region and 2 properties in the Sudbury District were visited by Resident Geologist Program staff; these visits are listed in Table 14. Locations, keyed to the property numbers, are shown in Figure 4.

Table 14. Property visits conducted by the Southern Ontario Resident Geologist's Office staff in 2022 (keyed to Figure 4).

Number	Client – Occurrence	Location (Township)
1	Crown William Mining Corp. - Bannockburn Gold	Madoc
2	Upper Canada Stone Company Ltd. - Green quarry	Huntingdon
3	Upper Canada Stone Company Ltd. - Clarence quarry	Madoc
4	A. Marmaro & Terrazzo Olympic LLC - Tweed Marble quarry	Hungerford
5	J. Martin and J. Andreana - Black Mountain graphite	Miller
6	J. Martin and J. Andreana - K9 marble / graphite property	Brougham
7	G Smith - Pay Rock gold occurrence	Barrie
8	G Smith - Ore Chimney mine	Barrie
9	Canadian Wollastonite - St. Lawrence mine	Leeds
10	Omya Canada Inc. - Omega Blue quarry	Darling
11	Omya Canada Inc. - Tatlock quarry	Darling
12	Hwy 7 Site 57	Marmora
13	Hwy 7 Site 53	Madoc
14	Craigmont corundum mine	Raglan
15	Hydro Line kyanite	Barrie

Number	Client – Occurrence	Location (Township)
16	Fluorite trench	Madoc
17	North Side occurrence	Marmora
18*	CGC Inc. - Hagersville gypsum mine	Oneida
19*	Brampton Brick Ltd. - Cheltenham quarry	Chinguacousy
20*	Rice and McHarg Quarries Limited - Rice and McHarg sandstone quarry	Esquesing
21	Stone Carver's Marble Tour**	Faraday
	Out of District Properties	
22	Northern Graphite Corp. - Bissett Creek graphite deposit, Sudbury District	Maria
23	B Brunette - Brunette graphite / garnet claims, Sudbury District	Maria

** Sites visited are in the Southwestern Ontario District and are not included on Figure 4.*
***Sites visited include the Hwy 62 East roadcut and Tweed, McMillan and Graf quarries.*

Rice and McHarg Quarries Limited – Esquesing Township

L.A. Mancini, M. Dorado-Troughton and L.A. Handley visited the Rice and McHarg Quarry site in September 2022. The property visit was guided by Ivan Rice.

The quarry was opened in 1953 by Joseph Rice and has remained a family run business to this day. The present owner-operators, brothers Joe and Ivan Rice took over management of the quarry from their father in the 1980s.

LOCATION AND ACCESS

The Rice and McHarg Quarry is in Esquesing Township, Concession 5, Lot 21. The quarry is off 5th Line approximately 1 km south of Limehouse and approximately 6 km southwest of Georgetown (Figure 5).

The operation was, for many years, the largest sandstone producer in the area employing 6 to 8 men and producing 100 t per day in a quarry only 3.4 ha in size (Guillet 1983). Today, the quarry covers 12.85 ha (Figure 6) and is licenced for a maximum of 20 000 t annually. Quarrying is done using pry bars, wedges, sledgehammers, and a minimal amount of blasting. Because of the quarrying methods used, there is very little dust, truck traffic, noise or risk to the environment created at the quarry (Guillet 1983).

Sandstone in the Rice and McHarg Quarry is extracted from the middle to upper units of the Lower Silurian Whirlpool Formation. In the Limehouse area, the Whirlpool Formation sandstone unconformably overlies the Upper Ordovician Queenston Formation and is overlain gradationally by the Manitoulin Formation (Martini and Salas 1983). Undeveloped areas of the quarry property containing the 1 to 2 m thick Whirlpool Formation sandstone, is covered by 2 m thick shale and 2 m thick clay (Photo 1) overburden (Guillet 1983).

At the Rice and McHarg Quarry, the Whirlpool Formation consist of yellow, pale blue, grey to greenish grey, and buff sandstone (Photo 2) with beds ranging from 60 cm to 1.8 m thick. Stratification and many sedimentary structures are visible on exposed bedding planes and fresh faces cut at different angles in the quarry. Sedimentary structures (Photos 3A and 3B) include cross beds, plane beds, trough-cross beds, and a variety of ripple marks (Martini and Salas 1983). The massive sandstone beds contain dark grey-black laminations that facilitates splitting the sandstone into thin slabs (Photo 4).

The Whirlpool Formation sandstone in the Rice and McHarg Quarry is of very good quality with good "reed" (easily split) and is easy to extract because of 2 sets of joints (Photo 5) trending east and north allowing the sandstone to be broken into large blocks (Martini and Salas 1983).

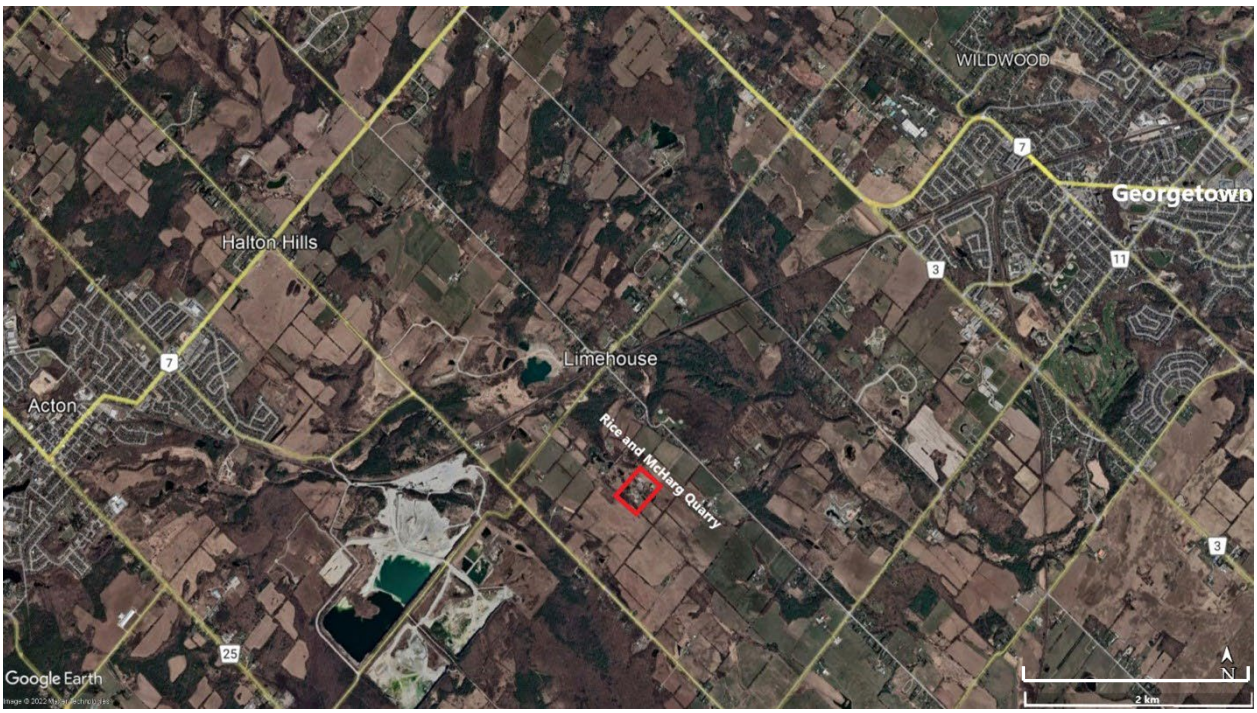

Figure 5. Location map of the Rice and McHarg Quarry (image *from* Google Earth™ mapping service, image © 2022 Maxar Technologies).

Figure 6. Aerial view of Rice and McHarg Quarry in 2021 (image *from* Google Earth™ mapping service, image © 2022 Maxar Technologies). The quarry covers most of the property's 12.85 ha.

Photo 1. Rice and McHarg Quarry Whirlpool Formation sandstone overlain by 2 m of shale and 2 m of clay overburden.

Photo 2. Whirlpool Formation sandstone colours in the Rice and McHarg Quarry include yellow with rusty highlights, brown, grey and greenish grey.

Photo 3. A) Linguoid ripple marks and **B)** sinuous ripple marks in Whirlpool Formation sandstone from the Rice and McHarg Quarry. Marker, for scale in A, is 13.5 cm long.

Photo 4. Fine dark grey to black laminations in the Whirlpool Formation sandstone allow for easy splitting, Rice and McHarg Quarry. Marker, for scale, is 13.5 cm long.

Photo 5. Joints and laminations in within the Rice and McHarg Quarry Whirlpool Formation sandstone. The black arrows point to one of the 2 joint sets and the red arrows point to the laminations.

K9 Graphite-Marble Property, Brougham and Matawatchan Township (M. Dorado-Troughton)

L.A. Mancini (Resident Geologist), M. Dorado-Troughton (District Geologist) and H. Craig (Summer Student) accompanied prospectors J. Martin and J. Andreana on an examination of their graphite and marble property in Brougham and Matawatchan townships. All UTM co-ordinates reported in the following description are provided using NAD83 in Zone 18.

LOCATION AND ACCESS

The K9 graphite project is located approximately 70 km east of Bancroft and 65 km south of Pembroke. The claim group straddles the boundary between Matawatchan Township to the west and Brougham Township to the east, and comprises 5 claim cells (Figure 7).

Access to the property is via Highway 41 east of Griffith, to Doorley Creek Road. The claims follow the logging road and the project is named after the kilometre 9 marker, which lines up approximately with the centre of the first claim encountered when traveling south on the road.

EXPLORATION HISTORY

Mineral exploration began in the Bancroft to Pembroke area in the mid-1800s. Several magnetite deposits achieved minor production of iron between 1868 and 1930 and molybdenum was produced from numerous small deposits from 1890 to 1942 (Carter, Colvine and Meyn 1980).

Industrial minerals (corundum, feldspar, apatite, garnet, mica, talc and graphite) were also produced in the area from the late 1800s to mid-1900s. The Black Donald graphite mine in Brougham Township, about 10 km southeast of the K9 property, was discovered in 1889 and was Canada's largest graphite producer until the mine closed in 1954 (Storey and Vos 1981). For more information on the history of graphite in southern Ontario, *see* "Graphite – Grey Gold" under "Recommendations for Exploration".

Exploration activity for graphite in the area has increased again in recent years, as the use of graphite in batteries and other technologies (fuel cells, brake linings, lubricants, steelmaking) continues to increase (Ontario Geological Survey 2022d). Since 2006, 4 geophysical surveys have been completed in Brougham Township (assessment files 20000008074, 20000008117, 20000003844 and 20000002508). In Matawatchan Township, some prospecting occurred in the early 2000s (assessment files 20000000225 and 31F03NE2001), but the majority of exploration activity has been focussed on the north end of J. Martin and J. Andreana's Black Mountain property near Centennial Lake (MDI000000003253).

In 2018, the Ontario Geological Survey published a geological map of the Centennial Lake area, which identified several new graphite occurrences near Big Limestone Lake, and 2 along the Doorley Creek Road (Duguet, Duparc and Mayer 2018). The K9 project area had not undergone any exploration prior to publication of this map.

In 2020, prospectors J. Martin and J. Andreana registered their initial, southernmost claims based on the published map and associated data (Duguet, Duparc and Mayer 2018; Duguet 2018, respectively). Prospecting, sampling and reconnaissance have continued each field season to date, with additional claim registration occurring after the location of the K9 graphite mineralization.

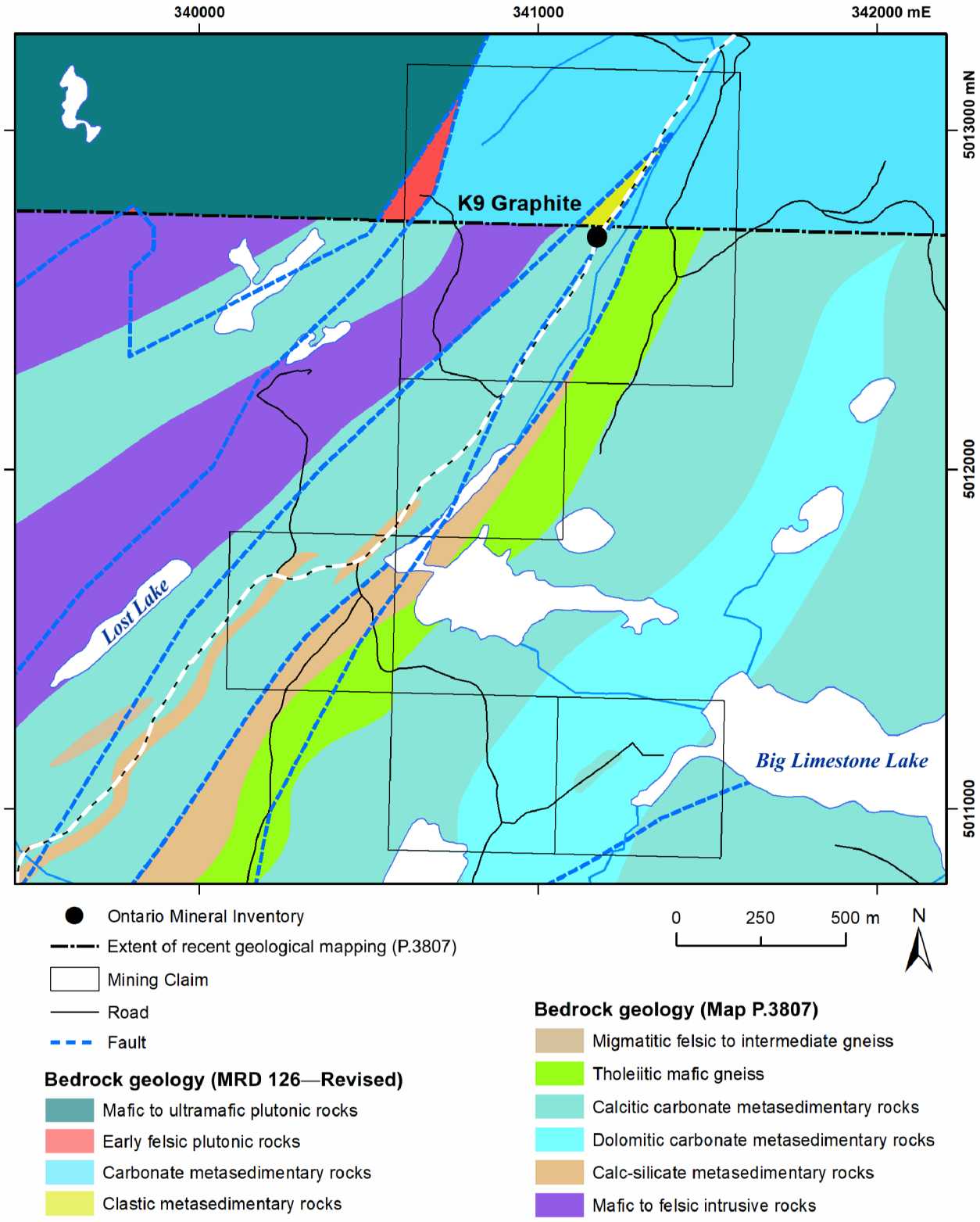

Figure 7. Geology in the area of the K9 graphite-marble prospect, Matawatchan and Brougham townships; geology *from* Duguet, Duparc and Mayer (2018: "Map P.3807") to the south and *from* Ontario Geological Survey (2011: "MRD 126—Revised") to the north. Note, Doorley Creek Road is indicated by black and white dashed line.

REGIONAL GEOLOGY

The following geological description is summarized *from* Duguet and Easton (2017), unless otherwise noted.

The K9 graphite-marble prospect (MDI000000003127) is located in the Centennial Lake area of the Black Donald domain in the northeastern part of the Central Metasedimentary Belt of the Grenville Province. The geology of the area is partially shown on a compilation map of the Denbigh area (Lumbers and Vertolli 2001) and on a more recent field-based map of the Centennial Lake area (Duguet, Duparc and Mayer 2018). The location and geology of the K9 property is shown in Figure 7.

The Black Donald domain can be subdivided into 3 lithostructural units: from west to east, they are the Lower, Intermediate, and Upper units. The K9 property lies across the thrust fault that separates the Lower unit from the Intermediate unit, although the K9-mineralization and the Doorley Creek Road area are within the Lower unit.

The Intermediate unit is predominated by calcitic and dolomitic marbles that occupy the core of a northeast-trending megasynform. The dolomitic marbles are clean, white to grey, coarse grained and massive. They are in stratigraphic contact with siliciclastic units that include rusty schists that host graphite-pyrrhotite mineralization (Duguet, Duparc and Mayer 2018).

The Lower unit appears to be the least lithologically complex of the 3 units. It hosts a large amphibolite unit at its centre and has a core of calcitic marble. The amphibolite units intrude the supracrustal rocks and it is likely that they were originally mafic sills. Calc-silicate schists and gneisses are present only locally.

The graphite-pyrrhotite-bearing mineralization found in the Intermediate unit show up as coincident magnetic high and conductivity anomalies on surveys conducted by Standard Graphite Corporation in the Black Donald Lake area (assessment file 20000008117: Desaulniers 2013).

PROPERTY GEOLOGY

The geology of the K9 property is shown in Figure 7. The property is only partially covered by the recent map of the Centennial Lake area (Duguet, Duparc and Mayer 2018), leading to differences in geological detail.

The K9 property claims straddle the thrust fault that separates the Black Donald domain's Lower unit to the west and the Intermediate unit to the east. The Intermediate unit on the K9 claims, consists of gneisses near the fault boundary, and calcitic and dolomitic marbles to the east. The Lower unit on the K9 property consists of graphite-mineralized calcitic marble with discordant calc-silicate gneissic units, and a mafic amphibolite unit.

During the property visit, staff investigated the property along the Doorley Creek Road with some off-road traverses, but the southern claims in the Intermediate unit were not visited. The main location studied and sampled was the roadside outcrop near the kilometre 9 marker (UTM 341174E 5012683N,;Photo 6). In outcrop, metre-wide fracture zones undulate across the marble. The unfractured, clean marble is pale blue, coarse grained and competent (Photos 7 and 8). The fractured zones are white yellow, slightly crumbly and are potentially altered or preferentially weathered. Disseminated graphite mineralization is consistent throughout the outcrop, on both sides of the road and along strike. Graphite is found as medium- to coarse-grained, round flakes interstitial to the calcite crystals.

Prior to the property examination, K9 property samples, collected by J. Martin and J. Andreana, were submitted to the Tweed office for rock descriptions and geochemical analysis.

Two samples (JM-21-01 and JM-21-02) were sent to Activation Laboratories Ltd. (Ancaster) for graphitic carbon infrared analysis, and mineralogy and grain-size analysis, respectively. Both samples were from the same outcrop (UTM 341230E 5012761N) of coarse-grained, white yellow, calcitic marble with disseminated, round graphite flakes up to 4 mm in diameter. Sample JM-21-01 returned 0.39% graphitic carbon and JM-21-02 returned 1.13 weight % graphite and 91.21 weight % calcite. The rest of the modal mineralogical results can be seen in Table 15. Grain-size analysis was completed on JM-21-02 as well, although testing occurs after sample processing that reduces the grains to be smaller than 1 mm, so most of the grains appeared to be fine grained. Grain liberation testing showed that, after crushing to 1 mm, 26% of the graphite area was free, 63% was locked in calcite and the remaining 11% was locked in other minerals.

Flake graphite is increasingly sought after for its use in battery technology. Flake size is also increasingly important for a graphite prospect—the larger the flake, the higher the purity of the graphite. Market terminology refers to any graphite flake over 300 μm (0.3 mm) as extra large or "jumbo". Extra large graphite flakes are worth significantly more than fine flake or amorphous graphite (Scogings 2015). Thus, the coarse-grained graphite flakes on the K9 property are likely very pure.

Although initial graphite grades are low, the K9 property warrants further investigation. The graphite is hosted in very high purity marble, which gives the property potential for dual industrial mineral potential with the right processing. The flake size of the graphite at the K9 property should be studied further, with and without mechanical processing, ideally through petrological studies. The extent of fractures and alteration in the marble should also be studied further, followed by brightness and colour testing on the marble.

Table 15. Modal mineralogical results for sample JM-21-0 2 from the K9 property.

Sample JM-21-02	Mineralogy (wt. %)
Graphite	**1.13**
Graphite Mixed	0.2
Quartz	0.6
Feldspar	2.43
Biotite	0.29
Muscovite	n.d.
Amphibole/Pyroxene	2.66
Chlorite	0.29
Epidote	0.59
Titanite	0.14
Fe Oxy/Hydroxide	0.22
Pyrite/Pyrrhotite	0.03
Calcite	**91.21**
Ankerite	0.01
Dolomite	0.01
Apatite	0.12
Others	0.07
Total	**100.00**

Photo 6. Roadside outcrop at the K9 property. Note colour and competency difference between the fractured and competent (blue-grey) unit. The competent unit blocks are outlined by white dashed lines. Hammer, for scale, is 42 cm long.

Photo 7. Blue graphitic calcite marble from the K9 property. Note millimetre-scale graphite flakes. Hammer, for scale, is 42 cm long.

Photo 8. Mineralized graphitic calcite marble from the K9 property. Note the shiny, silver and rounded graphite flakes. Sample is approximately 7 cm across.

RECOMMENDATIONS FOR EXPLORATION

Graphite – Grey Gold!

Note: The following recommendation is modified from *Mancini (2023).*

Graphite has been in use from at least the fifth millennium BCE as ceramic paint additive for pottery (Martino 2017), refractory material in molds, and in carbonizing steel, arc furnace electrodes, lubricants, brake linings, portable electronics (MacKinnon and LeBaron 1992) and—yes, pencils! Today, graphite is an essential component of batteries for electric vehicles and other technologies. Graphite is listed as a critical mineral in Ontario and globally.

In April 2020, Allied Market Research released a report stating the global graphite market, worth US$13.3 billion in 2019, is projected to increase to US$21.6 billion by 2027, with an anticipated compound annual growth rate (CAGR) of 5.3% from 2020 to 2027. This growth in the graphite market is driven by an increase in demand for lithium-ion batteries around the world as the use of electric vehicles continues to rise. Another driving factor in the increasing demand for graphite is the use of graphite electrodes in arc furnaces used in steel production (Allied Market Research, www.alliedmarketresearch.com/graphite-market, Graphite Market by Type [accessed September 13, 2022]).

SOUTHERN ONTARIO GRAPHITE POTENTIAL

Graphite has been mined in Ontario from at least the late 1800s to the 1990s. The Globe Mine (Figure 8), is the first documented graphite-producing mine in Ontario (MacKinnon and LeBaron 1992). The mine operated from 1870 to 1875 under the International Mining Company of New York, then intermittently to 1915 under different names. The Globe Mining and Refining Company operated the mine from 1915 to 1919 (MacKinnon and LeBaron 1992). In 1889, graphite was also discovered along the shores of Whitefish Lake in Renfrew County. By 1896, the site had become the Black Donald Mine (*The Eganville Leader*, www.eganvilleleader.ca/monthly-feature/black-donald-mines-buried-under-centennial-lake [accessed September 13, 2022]), which continued operating until 1954, producing both flake and amorphous graphite. The Black Donald Mine (*see* Figure 8) was the most important producer of graphite in North America, producing 87 000 t of graphite during its lifetime (LeBaron 2016). Three other mines operating during this period—Tonkin–Dupont (1911–1914), National Graphite (1915–1917), and Timmins (*see* Figure 8)—collectively produced 1000 t of graphite (LeBaron 2016). From 1989 to 1994, the Kearny Graphite Mine produced 17 000 t of flake graphite concentrate from around 1 Mt of ore (LeBaron 2016). During the 2015 field season, the OGS conducted a mapping and sampling program to better define the geology and mineral potential of the Centennial Lake area, just east of Matawatchan. The program resulted in the discovery of 5 new graphite occurrences approximately 13 km southwest of the Black Donald Mine, in the Centennial Lake area. The graphite is associated with sulphide-rich gneisses and schists (Duguet, Duparc and Mayer 2015).

Graphite occurrences in the Central Metasedimentary Belt are found mainly in the Bancroft and Frontenac terranes (*see* Figure 8) as flake and/or amorphous deposits in highly metamorphosed (upper amphibolite to granulite facies) sedimentary rocks (Rogers et al. 1995). These metasedimentary rocks consist of calcitic and dolomitic marbles and siliceous paragneisses. The graphitic metasedimentary rocks occur either within or adjacent to transition zones between marble units and the paragneisses (LeBaron 2016).

FURTHER READING

Several studies on the graphite potential of southern Ontario have been conducted over the years that examined graphite deposit types, environments and mineralogy. The studies, listed below, also have detailed descriptions of several deposits including past producers and prospects within the Central Metasedimentary Belt.

- *Graphite in Ontario*
  by D.F. Hewitt (1965)
- *Industrial Minerals of the Pembroke–Renfrew Area*
  by C.C. Storey and M.A. Vos (1981)
- *Graphite Development Potential in Eastern Ontario*
  by V.C. Papertzian and P.W. Kingston (1982)
- *Major Graphite Occurrences within the Frontenac Axis, Southeastern Ontario*
  by A. MacKinnon and P.S. LeBaron (1990)

RECOMMENDATIONS FOR EXPLORATION

With the predicted increase in demand for graphite over the next few years, it is recommended to revisit graphite occurrences in southern Ontario. A search of the Ontario Mineral Inventory (OMI) online database revealed more than 120 documented graphite occurrences in the Central Metasedimentary Belt, 34 of which are listed in Table 16 and their locations indicated in Figure 8. Although the majority are

currently on private or mining lands, many landowners are interested in the mineral potential of their properties and may be willing to negotiate an exploration agreement under the *Mining Act*. Alternately, the geological setting of the occurrences can be used as a model to explore new areas with similar geology.

Southern Ontario remains an excellent location for mineral exploration and development, and production, with its mineralogically diverse and complex geology. Excellent transportation infrastructure allows quick and efficient movement of products to local, national and international markets via roads, rail and Great Lakes shipping (Mancini 2022).

Table 16. Graphite occurrences in the Central Metasedimentary Belt of southern Ontario. Data *from* Ontario Mineral Inventory (OMI: Ontario Geological Survey 2022a). Deposits in **bold** are available for claims registration (as of March 14, 2023). Numbers in the first column refer to occurrences in Figure 8.

No.	Deposit Name / Township	OMI File No.	Commodity: Primary, Secondary	Mineralization Style	Rock Association(s)	Deposit Status	Land Status
1	Mount Irwin Galway	MDI31D15SE00016	gr Pb, Zn	[1]Disseminated flakes in marble	[1]Marble	Occurrence	Surface Rights Owned, Not open for claim registration
2	Miners Bay Lutterworth	MDI31D15SW00018	gr mb, msp	[2]Disseminated flakes in marble	[2]Marble	Occurrence	Surface Rights Owned, Not open for claim registration
3	Cedar Lake Lutterworth	MDI31D15SW00022	gr	[2]Disseminated flakes in marble	[2]Marble	Occurrence	Surface Rights Owned, Not open for claim registration
4	Otter Lake Lutterworth	MDI31D15SW00016	gr mb, py, po	[2]Disseminated flakes in marble	[2]Marble	Occurrence	Surface Rights Owned, Not open for claim registration
5	Birchbark Lake Snowdon	MDI31D15SE00036	gr	[1]Disseminated flakes in marble	[1]Marble	Occurrence	Surface Rights Owned, Not open for claim registration
6	Hot Spur Monmouth	MDI31D16NW00149	gr	[3]Disseminated flakes in marble	[3]Marble	Occurrence	Surface Rights Owned, Not open for claim registration
7	Concession XIII Lot 32 Monmouth	MDI31E01SE00014	gr	[3]Disseminated flakes in marble and pegmatite stringers	[3]Marble Pegmatite Syenite	Occurrence	Surface Rights Owned, Not open for claim registration
8	Concession XIV Lot 35 South Half Monmouth	MDI31E01SE00013	gr	[3]Lenses of disseminated flakes in marble	[3]Marble	Occurrence	Surface Rights Owned, Not open for claim registration
9	Virginia Graphite Co. Monmouth	MDI31E01SE00135	gr	[3]Disseminated graphite in foliations in marble	[3]Marble	Developed Prospect Without Reported Reserves or Resources	Surface Rights Owned, Not open for claim registration
10	**Bick Cardiff**	**MDI31E01SE00042**	**gr aln**	**[4]Disseminated graphite in seams in marble**	**[4]Marble**	**Prospect**	**Available Known Restrictions on claim holder**
11	Tonkin-Dupont prospect Cardiff	MDI31E01SE00078	gr	[4]Disseminated flakes in marble	[4]Marble Syenite	Prospect	Surface Rights Owned, Not open for claim registration
12	**Cupcake Lake Cardiff**	**MDI31E01SE00066**	**gr**	**[4]Disseminated flakes in paragneiss**	**[4]Paragneiss**	**Occurrence**	**Available Known Restrictions on claim holder**

No.	Deposit Name / Township	OMI File No.	Commodity: Primary, Secondary	Mineralization Style	Rock Association(s)	Deposit Status	Land Status
13	**Dickson and Riddell Cardiff**	**MDI31E01SE00227**	**gr po, Mo**	**[4]Disseminated flakes in siliceous paragneiss**	**[4]Paragneiss Gneiss Syenite**	**Occurrence**	**Available Known Restrictions on claim holder**
14	B.E. MacDougall Cardiff	MDI31E01SE00041	gr phl	[4]Disseminated flakes in syenite pegmatite	[4]Pegmatite Marble Gneiss	Occurrence	Surface Rights Owned, Not open for claim registration
15	Hound Lake Herschel	MDI31E01NE00012	gr	[5]Disseminated flakes in paragneiss and calcitic marble	[5]Paragneiss Marble	Prospect	Available No Known Restrictions on claim holder
16	F. Peever property Herschel	MDI31E01NE00013	gr	[4]Disseminated flakes in rusty gneiss	[4]Gneiss Pegmatite	Occurrence	Surface Rights Owned, Not open for claim registration
17	G. Rutledge property Monteagle	MDI31F04NW00015	gr	[4]Disseminated flakes in marble intruded by granite gneiss and pegmatite	[4]Marble Granite Pegmatite	Occurrence	Surface Rights Owned, Not open for claim registration
18	National Graphite (1915–1917) Tonkin-Dupont (1911–1914) Monteagle	MDI31F04NW00017	gr Mo, fel, msp	[4]Disseminated flakes in marble	[4]Marble Skarn Gneiss	Past Producer Without Reported Reserves or Resources	Surface Rights Owned, Not open for claim registration
19	Concession XIV Lots 13 and 14 Monteagle	MDI31F04NW00016	gr	[6]Disseminated flakes in a rusty paragneiss underlain by marble	[6]Paragneiss Marble	Prospect	Surface Rights Owned, Not open for claim registration
20	**Diamond Lake Creek Radcliffe**	**MDI31F05SE00066**	**gr**	**[4]Disseminated flakes in paragneiss**	**[4]Paragneiss**	**Discretionary Occurrence**	**Available Known Restrictions on claim holder**
21	Reid Lake Brudenell	MDI31F06NW00014	gr	[4]Disseminated flakes in syenite	[4]Syenite	Occurrence	Surface Rights Owned, Not open for claim registration
22	Dupuis Creek Lyndoch	MDI31F06SW00011	gr phl, po	[4]Bands of disseminated flakes in marble and paragneiss	[4]Marble Paragneiss	Occurrence	Surface Rights Owned, Not open for claim registration
23	Allanhurst Mine Denbigh	MDI31F03SW00002	gr phl	[5]Disseminated flakes and graphite seams in micaceous marble and disseminated flakes in pegmatite	[5]Marble Pegmatite Syenite	Developed Prospect Without Reported Reserves or Resources	Surface Rights Owned, Not open for claim registration
24	Beidelman and Lyall Lyndoch	MDI31F06SE00005	gr phl	[4]Bands of disseminated flakes in marble and paragneiss	[4]Marble Paragneiss	Developed Prospect with Reported Reserves or Resources	Surface Rights Owned, Not open for claim registration
25	G.K. Pearse property Griffith	MDI31F06SE00025	gr	[7]Disseminated flakes in veins cutting marble	[7]Marble Paragneiss	Discretionary Occurrence	Mining Claim

No.	Deposit Name / Township	OMI File No.	Commodity: Primary, Secondary	Mineralization Style	Rock Association(s)	Deposit Status	Land Status
26	Extra Griffith	MDI31F06SE00002	gr phl	[8]Disseminated flakes and very fine graphite smears following layering in marble	[8]Marble Paragneiss	Occurrence	Surface Rights Owned, Not open for claim registration
27	Green Lake Brougham	MDI31F07SW00011	gr tr	[8]Evenly disseminated flakes in marble	[8]Marble	Discretionary Occurrence	Surface Rights Owned, Not open for claim registration
28	Coronation Resources Brougham	MDI31F07SW00040	gr py	[8]Disseminated flakes in marble and [9]gneiss	[8]Marble 9Gneiss	Prospect	Mining Claim
29	**Boundary Scully Farm Blithfield**	**MDI31F07SW00036**	**gr**	**[4]Disseminated flakes in gneiss**	**[4]Gneiss Marble Pegmatite**	**Discretionary Occurrence**	**Available Known Restrictions on claim holder**
30	Indian River Darling	MDI31F01NW00002	gr	[4]Massive graphite in marble interbedded with paragneiss	[4]Marble Paragneiss Pegmatite	Prospect	Surface Rights Owned, Not open for claim registration
31	N.A. Timmins Mine Burgess	MDI31C09NW00013	gr Fe, Co, Zn, Ni	[10]Disseminated flakes in folded marble intercalated with paragneisses	[10]Marble Paragneiss Pegmatite	Past Producing Mine with Reported Reserves and Resources	Surface Rights Owned, Not open for claim registration
32	Burgess Graphite Burgess	MDI000000001198	gr	[10]Disseminated flakes in folded marble intercalated with paragneisses	[10]Marble Paragneiss Pegmatite	Prospect	Surface Rights Owned, Not open for claim registration
33	Meadow Lake Zone Bedford	MDI31C10SE00205	gr	[10]Disseminated flakes in folded marble intercalated with paragneisses	[10]Marble Paragneiss Granitic gneiss	Developed Prospect with Reported Reserves or Resources	Surface Rights Owned, Not open for claim registration
34	Bawden Mine Bedford	MDI31C10SE00024	gr	[10]Lenses, pods and disseminated flakes in marble intercalated with paragneisses	[10]Marble Paragneiss Granitic gneiss	Prospect	Surface Rights Owned, Not open for claim registration

Sources *for mineralization style and rock association(s) descriptions: [1]Easton 1987; [2]Easton 1990; [3]Armstrong and Gittins 1968; [4]Martin 1983; [5]Hewitt 1965; [6]Hewitt 1955; [7]Themistocleous 1981; [8]Storey and Vos 1981; [9]Hansen 1983; [10]MacKinnon and LeBaron 1990.*

Abbreviations*: aln, allanite; cp, chalcopyrite; fel, feldspar; gr, graphite; mb, marble; Mo, molybdenum; msp, mineral specimens; phl, phlogopite; po, pyrrhotite; py, pyrite; she, scheelite; tr, tremolite; tur, tourmaline.*

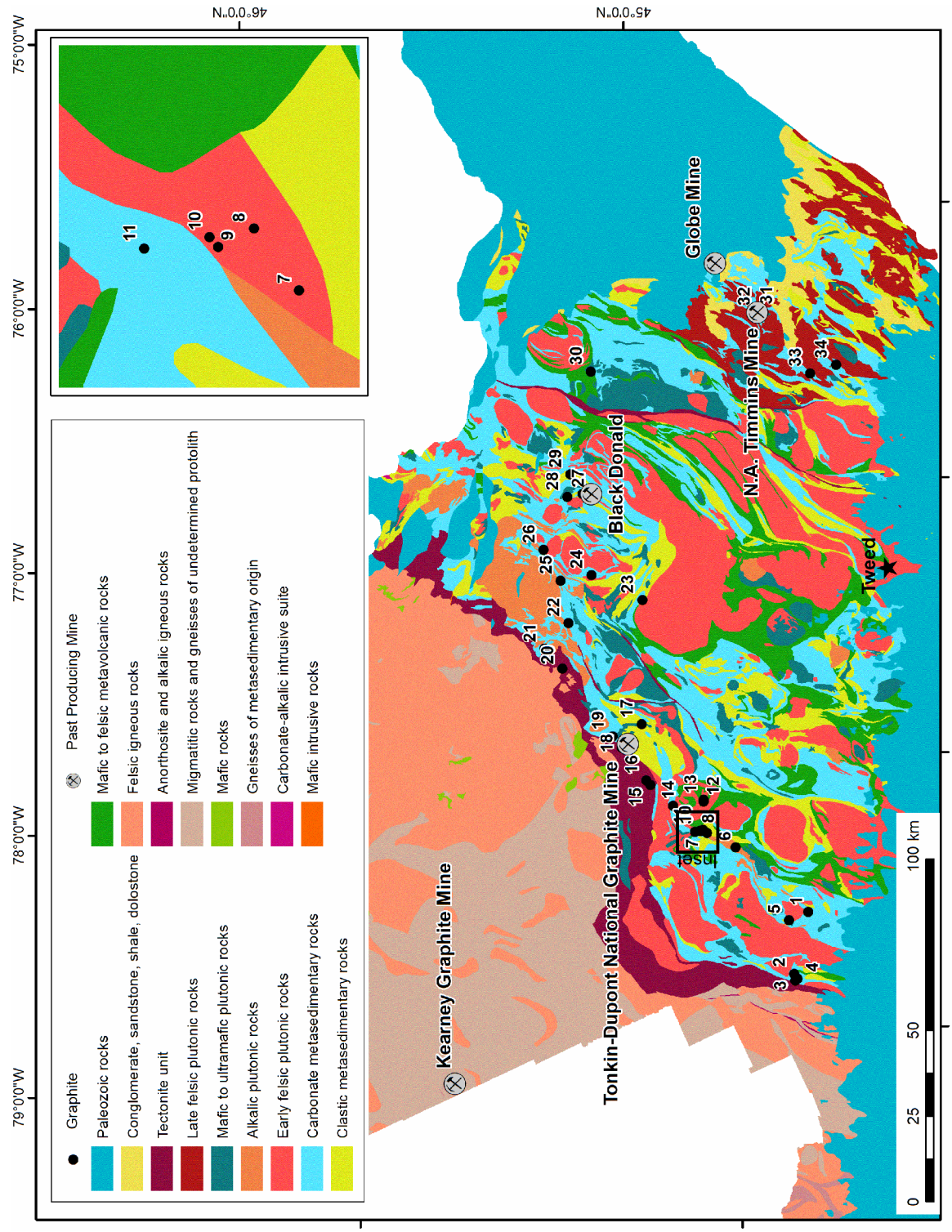

Figure 8. Simplified geological map of the Central Metasedimentary Belt of southern Ontario showing locations of graphite occurrences, prospects and past producers. Numbers on the map correspond to deposit names and the occurrence descriptions in Table 16 (data *from* the Ontario Mineral Inventory, Ontario Geological Survey 2022a). Geology *from* Ontario Geological Survey (2011).

Titanium and Vanadium in Southeastern Ontario – Untested Potential

Note: The following recommendation is modified from *Dorado-Troughton (2023).*

In March 2022, the Ontario government released its Critical Minerals Strategy for 2022–2027 (www.ontario.ca/page/critical-minerals). Titanium and vanadium feature on Ontario's critical minerals list and are also classified as critical minerals by Canada (Natural Resources Canada 2021) and the United States (United States Geological Survey, news release, February 22, 2022).

Both metals are important components of high-strength steel alloys, with demand increasing as vehicle manufacturers and construction companies tend toward creating lighter weight, fuel-efficient vehicles and lowering costs by improving the strength-to-weight ratio of material used. Vanadium-titanium alloys have the best strength-to-weight ratio of any engineered material yet discovered, and their combination with aluminum produces a material strong and stable enough for jet engines and high-speed airframes. There are currently no acceptable substitutes for vanadium in aerospace titanium alloys (Kelley et al. 2017).

A widely growing use for vanadium is in vanadium redox flow batteries (VRB), as they show great potential for stabilizing energy distribution in renewable energy systems. Vanadium redox flow batteries store energy in a nonflammable, liquid electrolyte; the batteries do not degrade with cycling and can be scaled and located with great flexibility, making them ideal for long-duration green energy storage (Kelley et al. 2017).

Vanadiferous titanomagnetite (VTM) deposits are the principal global source of vanadium (Kelley et al. 2017). Vanadiferous titanomagnetite deposits are made of magmatic accumulations of magnetite and ilmenite, and are mined for iron, titanium and vanadium. They occur as laterally extensive layers and thick tabular bodies, or as complex intrusions and lenses in mafic to ultramafic intrusions and metamorphic rocks. The ilmenite and magnetite may be remobilized by metamorphism and hydrothermal fluids after intrusion of syenite and alkalic igneous rocks (Kelley et al. 2017).

Iron-titanium-vanadium mineralization and potential deposits have been recognized across Ontario (Cundari and White 2015; LeBaron 2015; Puumala and Campbell 2019, 2020; Bousquet 2020; Péloquin 2021), but it is agreed that the Grenville Province (covering much of the Sudbury and Southern Ontario Resident Geologist Program (RGP) districts) holds most of Canada's titaniferous deposits (Rose 1969). E.R. Rose of the Geological Survey of Canada stated, "Large deposits of vanadium-bearing titaniferous magnetite are distributed in the Canadian Shield, particularly in the Grenville Province, associated with the gabbroic phase of anorthositic intrusions" (Rose 1973).

Of the many iron and iron-titanium occurrences in southeastern Ontario (Figure 9; Table 17), there are few with documented reports of vanadium, as iron occurrences historically may not have been analyzed for vanadium or titanium. The most significant are described below.

The Newboro deposit consists of 2 separate zones, known as the Matthews and Chaffey iron mines, which produced a total of about 20 000 t of iron ore between 1858 and 1871. Total estimated reserves (non-NI-43-101-compliant) within the 2 deposits are 45 Mt averaging 26% Fe and 6.6% TiO_2 (Carter 1984). Samples of ore material from rock dumps were reported to contain 0.1% V_2O_5 (Robinson 1922). The Methuen Township deposit, formerly known as the Twin Lakes ilmenite deposit and currently owned by Trigan Resources Ltd., consists of a zone of massive ilmenite within the cumulate zone of an anorthositic gabbro body about 4 by 2 km in surface area. Exploration of the deposit in the 1980s defined reserves of 13.2 Mt averaging 21.7% TiO_2 to a depth of 165 m (Sangster et al. 1999). A sample of massive ilmenite collected by staff of the Tweed Resident Geologist Office in 2011 contained greater than 1000 ppm V_2O_5 (LeBaron 2015) and samples collected during an unpublished study of the Crow River

Watershed returned greater than 2000 ppm V_2O_5 (Menard 1985). Other occurrences with anomalous vanadium content have been identified: the Pine Lake occurrence (up to 0.52% V_2O_5), a magnetite deposit within anorthositic gabbro; and the Orton occurrence (up to 0.34% V_2O_5), a magnetite zone at the margin of the Tudor gabbro (Menard 1985; Wilson 1994). These grades compare favourably to the average grade of vanadiferous titanomagnetite deposits: between 0.2 and 1 weight % V_2O_5 (Kelley et al. 2017).

Although the majority of known iron-titanium-vanadium occurrences in southeastern Ontario (*see* Figure 9; *see* Table 17) are on private land or have active claims currently, many landholders are amenable to agreements and exploration should not be discounted. Companies that currently hold iron occurrences are encouraged to further test for the potential and extent of titanium and vanadium mineralization. The waste rock and tailings piles of past-producing iron deposits warrant further study, as well, because vanadium is proven to collect in iron slag and could be recovered as a valuable by-product (Menard 1985; Kelley et al. 2017; Millar 2021).

Furthermore, exploration for new titanium- and vanadium-bearing iron oxide deposits is recommended in southeastern Ontario, particularly in association with gabbroic and/or anorthositic intrusions (*see* dark blue unit in Figure 9). The Lavant gabbro suite is a good candidate, with a large and layered intrusion and known magnetite occurrences (LeBaron 2015). Many of the known magnetite deposits and untested iron-titanium occurrences near similar intrusions should be sampled and analyzed for titanium and vanadium.

RECOMMENDATIONS

- Examine gabbroic and anorthositic intrusions and related environments for magmatic iron-titanium-vanadium occurrences, and possible remobilized mineralization.
- Examine, sample and analyze (X-ray fluorescence (XRF) recommended) known iron occurrences to determine if vanadium and/or titanium are associated with them.
- Further examine, sample and analyze waste rocks and tailings piles of past-producing iron mines for potential to recover overlooked vanadium and or titanium.

Table 17. Highlights from iron-titanium, iron-vanadium and iron-titanium-vanadium occurrences in southeastern Ontario, Southern Ontario Resident Geologist District. Data *from* Ontario Geological Survey (2022a). For a complete listing, *see* the Ontario Mineral Inventory (OMI) database or contact the author.

Property Name (Township)	OMI Number	Occurrence Status	Commodity (secondary)	Deposit Type
Calabogie deposit (Bagot)	MDI31F07SE00009	Developed Prospect with Reserves or Resources	Iron (vanadium)	Magmatic metasomatic
Culhane Mine (Bagot)	MDI31F07SE00071	Prospect	Iron (titanium, vanadium)	Metasomatic
South Road (Bagot)	MDI31F07NE00067	Occurrence	Iron (titanium)	Magmatic
West Bluff Point (Bagot)	MDI31F07SE00119	Occurrence	Iron (titanium)	Magmatic metasomatic
Pershing (Belmont)	MDI31C05NW00029	Occurrence	Magnetite (titanium, vanadium)	Magmatic metasomatic
Blithfield prospect (Blithfield)	MDI31F07SE00066	Occurrence	Magnetite (titanium)	Magmatic metasomatic
Michael A Murray (Burns)	MDI31F12SW00018	Discretionary Occurrence	Iron (titanium)	Magmatic
St Joseph (Cavendish)	MDI31D16SW00112	Occurrence	Iron, lead, zinc (titanium, vanadium)	Metasomatic
R.M. Easton samples (Cavendish)	MDI000000002463	Occurrence	Iron (titanium, vanadium)	Magmatic
Barnum Lake (Dysart)	MDI31E02SE00022	Discretionary Occurrence	Titanium	Metasomatic

Property Name (Township)	OMI Number	Occurrence Status	Commodity (secondary)	Deposit Type
Allen Lake (Harcourt)	MDI31E01SE00306	Discretionary Occurrence	Magnetite (titanium)	Magmatic
Chenaux Gabbro (Horton)	MDI31F10SE00019	Occurrence	Iron, titanium (vanadium)	Magmatic
Green Island Rutile (Huntingdon)	MDI31C06NW00088	Occurrence	Titanium	Hydrothermal
Tomahawk (Lake)	MDI31C12NW00002	Developed Prospect Without Reserves or Resources	Iron (copper, talc, titanium, vanadium)	Magmatic hydrothermal
Ricketts (Lake)	MDI31C12NE00109	Occurrence	Iron (titanium)	Magmatic
Maloney (Marmora)	MDI31C12SW00002	Past Producing Mine Without Reserves or Resources	Iron (nickel, copper, chromium, titanium)	Magmatic metasomatic
Ridgeway (Marmora)	MDI31C12SW00122	Occurrence	Iron (titanium, copper)	Magmatic metasomatic
Marsh Ore Bed (Marmora)	MDI31C05NE00135	Occurrence	Iron (titanium, gold)	Hydrothermal
McNab Mine (McNab)	MDI31F08NW00004	Prospect	Iron (hematite, titanium, vanadium)	Hydrothermal
MRT Aggregates – Trigan Resources (Methuen)	MDI000000002331	Producing Mine	Trap rock (titanium, iron, vanadium)	Magmatic
Methuen Township Ilmenite (Methuen)	MDI31C12NW00114	Developed Prospect with Reserves or Resources	Titanium (iron)	Magmatic
Canadian Nickel Company (Methuen)	MDI000000002332	Occurrence	Titanium	Magmatic
Horse Lake (Methuen)	MDI31C12NW00127	Occurrence	Iron, titanium	Magmatic
Gossan (Methuen)	MDI31C12NW00094	Discretionary Occurrence	Gabbro (titanium, iron)	Magmatic
Canadian Nickel (Methuen)	MDI31C12SW00121	Discretionary Occurrence	Titanium	Magmatic
Pioneer (Methuen)	MDI31C12NW00030	Occurrence	Trap rock (titanium, iron)	Magmatic
Canning Lake (Minden)	MDI31D15NE00052	Occurrence	Magnetite (titanium)	Metasomatic
Matthews Mine – Newboro deposit (North Crosby)	MDI31C09NW00009	Developed Prospect with Reserves or Resources	Magnetite, vanadium (titanium)	Magmatic
W.H. Strong (North Crosby)	MDI31C09NW00071	Occurrence	Magnetite (titanium)	Magmatic
Allan Mills (Seymour)	MDI31C05NE00146	Prospect	Magnetite (silver, vanadium)	Metamorphic metasomatic
Chaffey – Newboro deposit (South Crosby)	MDI31C09NW00011	Developed Prospect with Reserves or Resources	Magnetite (titanium)	Magmatic
Orton (Tudor)	MDI31C12NE00122	Past Producing Mine Without Reserves or Resources	Iron (titanium, vanadium)	Magmatic
Hastings Road magnetite (Tudor)	MDI31C12NE00185	Occurrence	Iron (titanium)	Magmatic
Harper Lake (Tudor)	MDI31C12NE00188	Occurrence	Magnetite, titanium	Magmatic
King (Wollaston)	MDI31C13SW00038	Occurrence	Titanium	Hydrothermal
Umfraville (Wollaston)	MDI31C13NW00057	Occurrence	Magnetite, uranium (phosphate, titanium, cobalt)	Magmatic

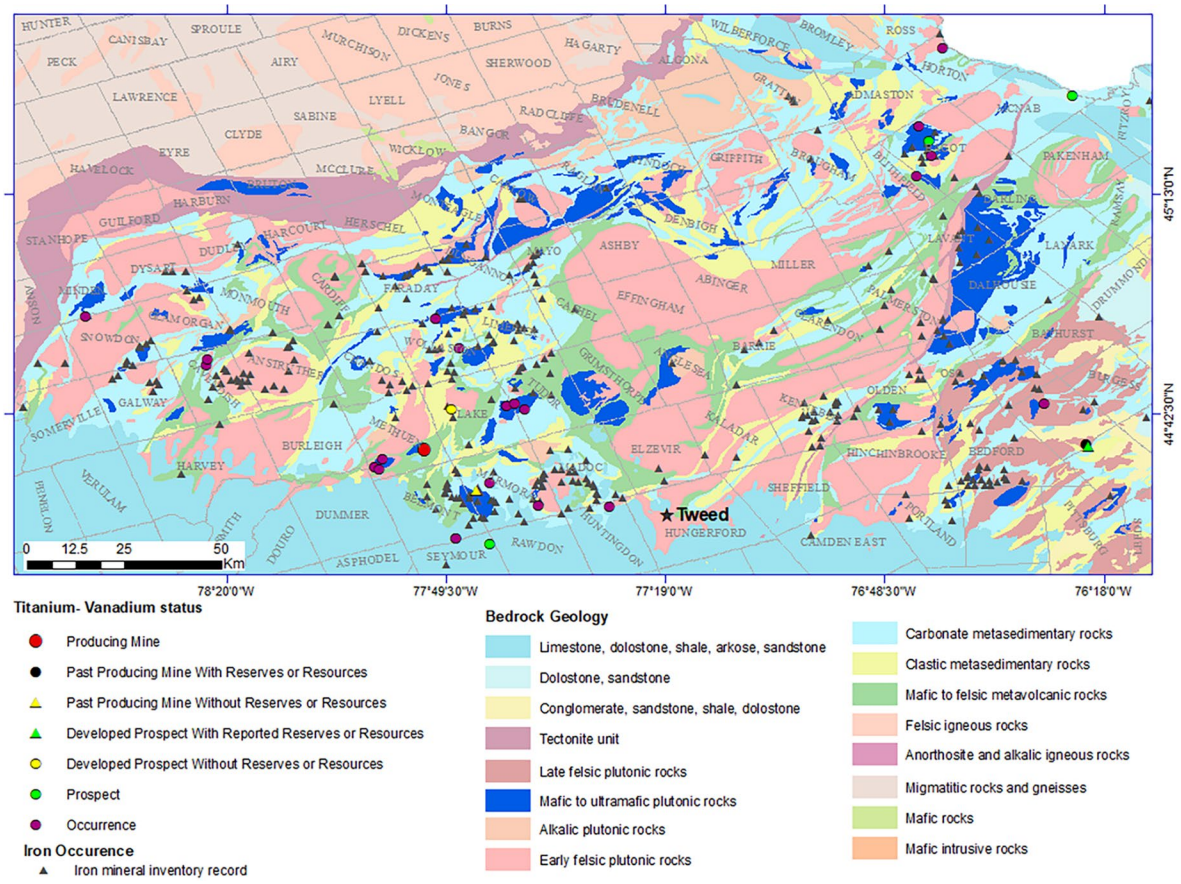

Figure 9. Map of southeastern Ontario, Southern Ontario Resident Geologist Program District, showing the location of documented titanium and vanadium occurrences and their association with iron occurrences and mafic intrusions (dark blue unit) (*see* Table 17; data *from* Ontario Mineral Inventory (Ontario Geological Survey 2022a); geology *from* Ontario Geological Survey 2011).

OGS ACTIVITIES AND RESEARCH BY OTHERS

Geological mapping and related projects in southern Ontario by staff of the Earth Resources and Geoscience Mapping Section, Ontario Geological Survey, continued during the 2022 field season.

- E.C.G. Hastie (OGS–ERGMS) continued work on a multi-year collaborative project between the Ontario Geological Survey, the Royal Ontario Museum and the Metal Earth research program. The project is developing a method for analyzing major and trace elements associated with gold and working toward a public database for gold geochemistry across Ontario and the world. The project currently makes use of samples from 4 deposits in the Southeastern Ontario District (Melo-Gómez et al. 2022).

A detailed description of the following projects is included in *Summary of Field Work and Other Activities, 2022* (Ontario Geological Survey 2022b):

Surficial Mapping and Sampling

- Sediment Mapping in the City of Ottawa, Southeastern Ontario, by R.P.M. Mulligan

Paleozoic Geology and Energy Studies

- Subsurface Stratigraphy of Early Silurian Medina Group Mixed Siliciclastic–Carbonate Strata, Southwestern Ontario: Final Update, by R.H. Paterson, F.R. Brunton, J. Jin, A.R. Phillips and K.H. Yeung
- Stratigraphy and Sedimentology of Upper Ordovician Strata, with Emphasis on the Collingwood and Rouge River Members, Southern Ontario and Manitoulin Island, by D. Atasiei, C.J. Tsujita, F.R. Brunton, J. Jin and K.H. Yeung
- Revisiting the Cambrian Stratigraphy of Southwestern Ontario, by A.R. Phillips, F.R. Brunton and K.H. Yeung
- Paleozoic Geology of the Kingston Area, Eastern Ontario, by K.E. Hahn
- Paleozoic Geology of Eastern Ontario: Russell–Thurso Area, by C. Béland Otis

Groundwater Studies

- From Mighty Moraines to Dramatic Drumlins: Introducing the Guelph Three-Dimensional Sediment Mapping Project, by A.K. Burt and G.W. Hagedorn
- South Ottawa Groundwater Study, Eastern Ontario, by T. Di Iorio, S. Foubister and C.N. Bocking

The first annual OGS Virtual Showcase was held from October 25 to 27, 2022. Beginning December 15, 2022, selected presentations were made available to download until October 31, 2023 (note: not all presenters made recordings available). The presentations are provided in video format and are accompanied by the OGS Virtual Showcase 2022 Technical Program and other documentation. Presentations relevant to the Southern Ontario Region are listed in Table 18.

New publications received by the Southern Ontario Resident Geologist office in 2022 that document recent geoscience projects in the district are listed in Table 18.

Table 18. Publications released by the Ontario Geological Survey and/or received by the Southern Ontario Regional Geologist office in 2022.

Title	Author	Type and Year of Publication
Report of Activities 2021, Resident Geologist Program, Southern Ontario Regional Resident Geologist Report: Southeastern and Southwestern Ontario Districts, and Petroleum Operations Centre	L.A. Mancini, M. Dorado-Troughton, N. Sabiri, P.S. LeBaron, S.L.K. Hinz, G. Dorland and L. Fortner	Ontario Geological Survey, Open File Report 6386 (2022) (Mancini et al. 2022)
Recommendations for Exploration, 2021–2022	Ontario Geological Survey	Ontario Geological Survey, Resident Geologist Program, Recommendations for Exploration (2022) (OGS 2022c)
An Introduction to Ontario's Critical Minerals, With Highlights from the Ontario Mineral Inventory	Ontario Geological Survey	Ontario Geological Survey, Resident Geologist Program (2022) (OGS 2022d)
Recommendations for Exploration Special Edition: Critical Minerals Compilation 2000–2022	Ontario Geological Survey	Ontario Geological Survey, Resident Geologist Program, Recommendations for Exploration Special Edition (2022) (OGS 2022e)
Summary of Field Work and Other Activities, 2022	Ontario Geological Survey	Ontario Geological Survey, Open File Report 6390 (2022) (OGS 2022b)
Specific articles of interest:		
Trace Element Content of Gold Across Ontario: An Update on the Gold Fingerprinting Project	J.D. Melo-Gómez, E.C.G. Hastie, H.L. Gibson, K.T. Tait and J.A. Petrus	OFR 6390, article 15
Summary of Geophysical Projects and Activities	S. Biswas and J. Evangelatos	OFR 6390, article 16
Sediment Mapping in the City of Ottawa, Southeastern Ontario	R.P.M. Mulligan	OFR 6390, article 18
Subsurface Stratigraphy of Early Silurian Medina Group Mixed Siliciclastic–Carbonate Strata, Southwestern Ontario: Final Update	R.H. Paterson, F.R. Brunton, J. Jin, A.R. Phillips and K.H. Yeung	OFR 6390, article 19
Stratigraphy and Sedimentology of Upper Ordovician Strata, with Emphasis on the Collingwood and Rouge River Members, Southern Ontario and Manitoulin Island	D. Atasiei, C.J. Tsujita, F.R. Brunton, J. Jin and K.H. Yeung	OFR 6390, article 20
Revisiting the Cambrian Stratigraphy of Southwestern Ontario	A.R. Phillips, F.R. Brunton and K.H. Yeung	OFR 6390, article 21
Paleozoic Geology of the Kingston Area, Eastern Ontario	K.E. Hahn	OFR 6390, article 22
Paleozoic Geology of Eastern Ontario: Russell–Thurso Area	C. Béland Otis	OFR 6390, article 23
From Mighty Moraines to Dramatic Drumlins: Introducing the Guelph Three-Dimensional Sediment Mapping Project	A.K. Burt and G.W. Hagedorn	OFR 6390, article 24
South Ottawa Groundwater Study, Eastern Ontario	T. Di Iorio, S. Foubister and C.N. Bocking	OFR 6390, article 25
Osmium Analysis at the Geoscience Laboratories by Nickel Sulphide Fire Assay with Inductively Coupled Mass Spectrometric Finish	O.M. Burnham	OFR 6390, article 26
Expansion of the Capabilities of the Geoscience Laboratories Methods for the Analysis of Trace Elements Important to Ontario's Critical Minerals Strategy	O.M. Burnham	OFR 6390, article 27
Summary of Quality Control Data for the Geoscience Laboratories Methods IMC-100, IMO-100 and IMP-101	J.C. Hargreaves	OFR 6390, article 28
Revision of the Calibration for Trace Element Analysis of Geological Samples by Wavelength Dispersive X-Ray Fluorescence at the Geoscience Laboratories	G.L. Keating	OFR 6390, article 29
Catching it by the Tailings: An Introduction to the Ontario Geological Survey Critical Minerals Mine Waste Sampling Project	D.J. Bennett	OFR 6390, article 32

Title	Author	Type and Year of Publication
Tritium in Shallow Groundwater of Southern Ontario	E.H. Priebe and S.M. Hamilton	Ontario Geological Survey, Groundwater Resources Study 20 (2022) (Priebe and Hamilton 2022)
Index to Published Reports, Maps and Digital Data, 2016–2020	Ontario Geological Survey	Ontario Geological Survey, Supplement to Miscellaneous Paper (MP) 177 (2011–2020) (2022) (OGS 2022f)
Geographic Index to Published Reports, Maps and Digital Data, 2016–2020	Ontario Geological Survey	Ontario Geological Survey, Supplement to Miscellaneous Paper (MP) 178 (2011–2020) (2022) (OGS 2022g)
OGS Showcase	Ontario Geological Survey	Ontario Geological Survey Virtual Showcase 2022, October 25–27 (2022) (OGS 2022h)
Specific presentations of interest:		
Ontario Critical Minerals Projects and Exploration Opportunities	M.A. Puumala	presentation SHOWCASE-22-103 (2022)
Catching it by the Tailings: An Introduction to the OGS Critical Minerals Mine Waste Sampling Project	D.J. Bennett	presentation SHOWCASE-22-104 (2022)
Analytical Developments at the OGS's Geoscience Laboratories in Support of Ontario's Critical Minerals Strategy	O.M. Burnham	presentation SHOWCASE-22-110 (2022)
The Role of the Geoscience Laboratories Mineralogy Section in Supporting Ontario Geological Survey Projects	D.C. Crabtree and S.A. Clarke	presentation SHOWCASE-22-111 (2022)
Producing and Delivering the Best Provincial Geoscience Data for Users	C. Castrechino	presentation SHOWCASE-22-112 (2022)
Demo of OGSEarth Data Sets Including OGSFocus and the OGS GeoData Listing	G. Dorland	presentation SHOWCASE-22-113 (2022)
Adding New Data Sets: A Work in Progress	S. Préfontaine	presentation SHOWCASE-22-114 (2022)
Resident Geologist Program's Drill Core Libraries – An Invaluable Tool for Exploration	D.-A. Metsaranta	presentation SHOWCASE-22-116 (2022)
Exploration, Mining and Resident Geologist Program Activity Update for Southern Ontario	L.A. Mancini	presentation SHOWCASE-22-209 (2022)
From Mighty Moraines to Dramatic Drumlins: Introducing the Guelph 3-D Sediment Mapping Project	A.K. Burt and G.W. Hagedorn	presentation SHOWCASE-22-210 (2022)
Correlating the Basal Paleozoic Succession in Southern Ontario - From Chaos to Clarity	C. Béland Otis, K.E. Hahn and F.R. Brunton	presentation SHOWCASE-22-212 (2022)
Geological Mapping of Potentially Alkali Carbonate Reactive Beds in the Kingston Area	K.E. Hahn	presentation SHOWCASE-22-213 (2022)
Geologic Controls on Porosity and Permeability in the Silurian Lockport Group and Salina Group A-1 Carbonate, Southwestern Ontario	S. Sun, F.R. Brunton, T.R. Carter, J. Jin and H.A.J. Russell	presentation SHOWCASE-22-214 (2022)
Subsurface Correlation of the Lower Silurian Medina Group, Southwestern Ontario – 2022	R.H. Paterson, F.R. Brunton, J. Jin and A.R. Phillips	presentation SHOWCASE-22-215 (2022)
Probing the Earth: Geophysics at the OGS	S. Biswas and J. Evangelatos	presentation SHOWCASE-22-310 (2022)
Resident Geologist Program's Land Use Geology – Informing Land-Use Planning Decisions	C.M. Daniels	presentation SHOWCASE-22-311 (2022)
Petrogenesis of Pseudocarbonatites in the Bancroft Region, Southwestern Grenville Province	A.T. Mar	University of Waterloo, MSc thesis, 98p. (2022) (Mar 2022)
Subsurface Correlation of Lower Silurian Medina Group, Southwestern Ontario	R.H. Paterson	University of Western Ontario, MSc thesis (2022) (Paterson 2022)

University Research and Collaborations

The following information was provided to and compiled by the Southern Ontario Regional Resident Geologist's office concerning research projects by faculty and graduate students at various accredited universities, which were in progress or were published in 2022. This section is not a comprehensive summary of university research in the Southeastern Ontario and Southwestern Ontario districts, as it is based largely on information provided directly by university researchers.

- R.J. Botor (Queen's University) continued a PhD study started in September 2020. The investigation of the petrogenesis of the various suites of alkaline rocks in the Grenville Province in southern Ontario and their temporal and genetic relationship with the various styles of zinc mineralization is supervised by Dr. G. Olivo and Dr. M. Leybourne. This study involves field mapping, lithogeochemistry, mineral chemistry and isotopic investigation to determine their signature and ages. This will be complemented, for comparison, by age determinations of the zinc mineralization. (G. Olivo, Queen's University, personal communication, January 2021)
- S. Dyer (University of Waterloo) is continuing to study fluid-flux melting in the Muskoka domain, its mechanisms, and the source of those fluids as part of PhD research.
- C. Kinney (University of Waterloo) is researching the production and transfer of heat from the Battersea pluton to the surrounding metasedimentary units of the Proterozoic Grenville Province as part of a PhD thesis supervised by Dr. C. Yakymchuk.
- R.H. Paterson (University of Waterloo) completed an MSc thesis entitled "Subsurface Correlation of Lower Silurian Medina Group, Southwestern Ontario" under the supervision of Dr. J. Jin and F.R. Brunton (OGS – ERGMS) (Paterson 2022). Subsurface mapping in central and eastern Lake Erie has resulted in the recognition of three stratigraphic packages within the Medina Group based upon the integration of sedimentologic, stratigraphic and geophysical borehole logs.
- D. Garcia Ramos (Queen's University) completed an MSc thesis entitled "Thermal History of the Frontenac Arch in Southeastern Ontario, Canada Constrained from Low-Temperature Thermochronology" under the supervision of Dr. L. Godin. The research aims to understand the building mechanism and timing of southeastern Ontario's basement topography.
- A.T. Mar (University of Waterloo) completed an MSc thesis entitled "The Petrogenesis of Pseudocarbonatites in the Bancroft Region, Southwestern Grenville Province" under the supervision of Dr. C. Yakymchuk (Mar 2022). The research determined that the calcite-rich rocks in the Bancroft area were derived from partial melting of marbles at high temperature, based off trace element compositions, REE concentrations and patterns, and isotopic ratios.
- J. Melo-Gómez (Laurentian University) continued research with the Gold Fingerprinting project as part of MSc research supervised by E.C.G. Hastie (OGS – ERGMS). The project is in its second phase, which involves the analysis of gold, beginning with the gold deposits of Ontario. The project currently makes use of samples from 4 deposits in the Southeastern Ontario District (Melo-Gómez et al. 2022).
- L. Clancy (Queen's University) began an HBSc thesis project that involves mapping the geology of Frontenac Provincial Park, in partnership with a local organization known as the Friends of Frontenac Provincial Park.
- S. Ballantyne, P. Ruscica, H. Daxberger and P. Ashwell (University of Toronto) published *Atlas of the Central Gneiss Belt Bedrock Geology in Southern Ontario* and *Atlas of the Central Metasedimentary Belt Bedrock Geology in Southern Ontario.* The geological reference books are freely available online, with three-dimensional models of outcrops, rock samples, geochemistry and virtual thin sections. The goal of the publications is primarily to provide virtual teaching materials for post secondary earth science educators.

MINERAL DEPOSITS NOT BEING MINED

Tables 19 through 23 list currently inactive mineral deposits with identified resources and past-producing mineral occurrences.

Table 19. Titanium, tantalum and REE occurrences (*compiled from* OMI database: Ontario Geological Survey 2022a) – Southeastern Ontario District.

Name	Township	OMI 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

Name	Township	OMI File #	Commodity	Deposit Status
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
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: *OMI 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 the complete OMI files are located at RGP office in Tweed.*

Table 20. Past-producing magnetite mines – Southeastern Ontario District.

Deposit / Township	Ontario Mineral 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

Deposit / Township	Ontario Mineral Inventory Number (Status)	Description	Reference*
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

***Sources:** "MDC 20" = Carter, Colvine and Meyn (1980); "MP 161" = LeBaron et al. (1993); "MRC 11" = Shklanka (1968); "OFR "5515" = Carter (1984).*
(Publication series Mineral Resources Circular (MRC) [No.1-14], then renamed to Mineral Deposit Circular (MDC) [No.15–].)
***Note:** The resource estimates listed in this table are historical figures and do not follow the required disclosure for reserves and resources as outlined in National Instrument 43-101.*

Table 21. Uranium deposits not currently being mined in the Southeastern Ontario District.

Deposit Township	OMI Number	Commodity	Reserve	Reserve Reference
Zenmac Burleigh, Anstruther Tps.	MDI31D09NE00033 (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 t 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.	MDI31D16NE00032 (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.	MDI31D16NE00043 (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.	MDI31D16NE00143 (Developed Prospect w Reserves)	U, REE	Reserves estimated at 292 444 tons at 0.095% U_3O_8 within 500 feet of shaft and 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.	MDI31D16NE00146 (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.	MDI31D16NE00165 (Prospect)	U, Th	Estimated reserves: 200 000 tons averaging 0.20% U_3O_8 (1955)	OFR 5311, p.101
Rare Earth #1 Monmouth Tp.	MDI31D16NW00195 (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.	MDI31D16SE00059 (Developed Prospect w/o Reserves)	U	not known	
Garland Anstruther Tp.	MDI31D16SW00093 (Prospect)	U, Th	not known	
Cavendish Cavendish Tp.	MDI31D16SW00099 (Prospect)	U, Th	Estimated reserves: 435 624 tons grading 0.096% U_3O_8 (chemical)	OFR 5311, p.476
Bicroft (Croft) Cardiff Tp.	MDI31E01SE00224 (Prospect)	U	Estimated reserves in 3 zones: 979 810 tons grading 1.20 pounds U_3O_8 per ton	OFR 5311, p.84-85

Deposit Township	OMI Number	Commodity	Reserve	Reserve Reference
Fission Cardiff Tp.	MDI31E01SE00235 (Prospect)	U, Th, F	not known	
Baumhour–Campbell Faraday Tp.	MDI31E01SE00248 (Prospect)	U, Th	not known	
Mell–Quirke Monteagle Tp.	MDI31F04NE00067 (Prospect)	U, Th	not known	
Greyhawk Mine Faraday Tp.	MDI31F04SW00036 (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.	MDI31F04SW00037 (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

***Sources:** "MDC 23" = Masson and Gordon (1981); "MRC 4" = Hewitt (1967); "OFR 5311" = Gordon, Rybak and Robertson (1981); "OFR 5635" = Menard (1987).*
(Publication series Mineral Resources Circular (MRC) [No.1-14], then renamed to Mineral Deposit Circular (MDC) [No.15–].)
***Note:** The resource estimates listed in this table are historical figures and do not follow the required disclosure for reserves and resources as outlined in National Instrument 43-101.*

Table 22. Mineral deposits not currently being mined in the Southeastern Ontario District. (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]
MLS ..... Mining Lands, Sudbury
MP ..... Miscellaneous Paper
NM ..... *The Northern Miner*
OFR ..... Open File Report
OMI ..... Ontario Mineral Inventory
PC ..... Personal Communication
Status: A; E; I; M ..... Active; Exploration; Inactive, Mining

Deposit Name Township	OMI File Number (Southern Ontario No.)	Status	Commodity	Reserves	Reserve Reference
Ore Chimney prospect Barrie Township	MDI31C14SE00142 (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	MRC 12, p.132; MDC 18, p.33
Macassa Nickel Limerick Township	MDI31C13SE00099 (SO 0595)	AE	Ni, Cu	2 000 000 tons @ 1.0% Ni, 0.25% Cu	MRC 12, p.138
Renfrew Zinc (Renprior) Admaston Township	MDI31F07NE00063 (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	MRC 12, p.226; MDC 20, p.17
Harvey Simon prospect Lyndoch Township	MDI31F03NW00044 (SO 0259)	AE	Cu, Fe, Zn	250 000 tons @ 1.1% Cu to 350 feet	MRC 12, p.226; MDC 20, p.45
Clyde Forks deposit Lavant Township	MDI31F02SE00064 (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	MDI31C12NW00114 (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	MDI31F06NE00017 (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	MDI31F02NE00012 (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, p.104

Deposit Name Township	OMI File Number (Southern Ontario No.)	Status	Commodity	Reserves	Reserve Reference
Bessemer deposit Mayo Township	MDI31F04SE00012 (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	MDI31F04SE00013 (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	MDI31F07SE00009 (SO 0353)	AE	Fe	Reserves of 45 million tons @ 25% Fe to 500 feet and 28% Fe to 1000 feet	MRC 11, p.314
Buckhorn deposit Bagot Township	MDI31F07NE00069 (SO 0362)	I	Mo	Largest of numerous small lenses contains 1500 tons @ 1% MoS_2	MDC 20, p.132
Bannockburn (Madoc Mining Company Ltd.) Madoc Township	MDI31C12NE00195 (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	MDI31C11SW00044 (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	MDI31C12SE00040 (SO 3590)	AE	Au	11.6 Mt @ 0.97 g/t Au	OFR 6296, p.50-51
Hawley Ram Petroleum Limited Olden Township	MDI31C10NW00117 (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	MDI31C12SE00096 (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	MDI31C11SW00049 (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	MDI31C10SE00023 (SO 1244)	A	Graphite	1.6 Mt grading 9.5% graphite in 2 separate zones	MDC 33, p.16
Cal Graphite Corp. Butt Township	MDI31E11NE00004 (NO 129)	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	MDI31C16SE00016 (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	MDI31C12SW00005 (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	MDI31C09NW00009 (SO 1466) MDI31C09NW00011 (SO 1469)	I	Iron, titanium	45 Mt proven and probable averaging 26.24% Fe, 6.60% TiO_2	OFR 5515, p.316
Madawaska Mine Faraday Township	MDI31F04SW00037 (SO 0223)	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	MDI31C11NE00010 (SO 0882)	I	Gold	Total geological reserve of 758 000 tons grading 0.14 ounces per ton Au	OFR 5808, p.71

***Sources:** "MRC 11" = Shklanka (1968); "MRC 12" = Shklanka (1969); "MDC 18" = Gordon et al. (1979); "MDC 20" = Carter, Colvine and Meyn (1980); "MDC 33" = MacKinnon and LeBaron (1992); "MP 161" = LeBaron et al. (1993); "OFR 5515" = Carter (1984); "OFR 5715" = MacKinnon (1990); "OFR 5808" = LeBaron (1991); "OFR 5943" = Kingston, Papertzian and Sangster (1996); "OFR 5945" = Rogers (1996); "OFR 5958" = Kingston and Papertzian (1997); "OFR 6296" = Sangster et al. (2014). (Publication series Mineral Resources Circular (MRC) [No.1-14], then renamed to Mineral Deposit Circular (MDC) [No.15–].)*

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

Table 23. Mineral deposits not currently being mined in the Southwestern Ontario District.

Abbreviations

AF ..... Assessment Files
AR ..... Annual Report
CAMH ..... *Canadian and American Mines Handbook* [*since* 2004–2005]
CMH ..... *Canadian Mines Handbook* [*up to and including* 2003–2004]
GR ..... Geological Report
IMR ..... Industrial Mineral Report
MDC ..... Mineral Deposit Circular [No.15–] [*formerly* Mineral Resources Circular, No.1–14]
MLS ..... Mining Lands, Sudbury
MR ..... Mining Recorder
NM ..... *The Northern Miner*
OFR ..... Open File Report
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
Tweed Marble Quarry (31C/11SW)	Marble	20 x 20 m by 10 to 15 m deep	A Marmora & Terrazzo Olympic LLC	OFR5583, p.233-5 OFR5712, p.75-7	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

***Sources:** "IMR 9" = Hewitt (1963); "OFR 5861" = Russell (1993).*

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

REGIONAL LAND USE GEOLOGIST ACTIVITIES—SOUTHERN REGION

Land-Use Planning Activities

The southern Regional Land Use Geologist (RLUG), based in Tweed, co-ordinates input into land-use planning activities in the Southern Ontario Resident Geologist District (southeastern Ontario and southwestern Ontario districts), part of the Sudbury District south of the French River, including Manitoulin Island, and part of the Sault Ste. Marie District (St. Joseph Island). In 2022, the southern Regional Land Use Geologist position was staffed by Peter LeBaron, *P.Eng*.

The boundaries of the Regional Land Use Geologists' regions are indicated on Figure 10.

Figure 10. Extent of the Regional Land Use Geologists' ("RLUG") 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
- 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 2022, Regional Land Use Geologist staff dealt with a variety of land-use planning issues throughout the southern region. The following sections summarize the work that was done.

CROWN LANDS

In July of 2022, the former Ministry of Northern Development, Mines, Natural Resources and Forestry (NDMNRF) was divided to create 3 separate Ministries: Ministry of Mines (MINES), Ministry of Northern Development (MND) and Ministry of Natural Resources and Forestry (MNRF). The Ministry of Mines continues to be responsible for all geoscience mapping within the province through the Ontario Geological Survey (OGS) and administers mineral exploration and development under the *Mining Act*. Natural Resources and Forestry is responsible for mineral aggregate extraction under the *Aggregate Resources Act*, in addition to being responsible for mapping and regulating many other natural resource features and activities.

The Ministry of Mines (MINES), through the Regional Land Use Geologist, 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; 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*, such as the *Mining Act*.

In 2022, there were no new Forest Management Plans submitted to the southern Regional Land Use Geologist for comments and input.

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 Natural Resources Information Portal (https://nrip.mnr.gov.on.ca/s/fmp-online).

Parks and Protected Areas

In 2022, the southern Regional Land Use Geologist received a request from the Ministry of Transportation and the Ministry of Natural Resources and Forestry regarding proposed rock-cut scaling along Highway 7 in 2 areas that are designated as Areas of Natural and Scientific Interest (ANSIs). The rock cuts, in Madoc and Marmora townships, Hastings County, were examined by staff of the southern Ontario Regional

Resident Geologist Office in Tweed to determine whether the proposed rock removal could impact the integrity of the ANSIs. It was concluded that the operation will not adversely impact the rock exposures that are the basis for the ANSI designation.

MUNICIPAL AND PRIVATE LANDS

The Ministry of Mines supports municipal and private land-use planning through the One Window Planning Service, led by the Ministry of Municipal Affairs and Housing (MMAH), and through the Municipal Plan Review process where a municipality has approval authority. 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 helps to ensure that municipal Official Plans recognize mining operations and areas with significant mineral potential, so that they can be protected from incompatible land uses. The PPS was last modified in 2020. There were no revisions in 2020 directly applicable to the review process of the Regional Land Use Geologist. All municipalities in Ontario were required to update their Official Plans to conform with the 2020 version of the PPS by July 2022.

In October 2022, MMAH began a policy review of A Place to Grow and the Provincial Policy Statement (http://ero.ontario.ca/notice/019-6177), seeking input on how to create a streamlined province-wide land use planning policy framework that enables municipalities to approve housing faster and increase housing supply.

As a participant in MMAH's One Window Planning Service for Official Plans and their amendments, the Regional Land Use Geologist provides comments, mineral values mapping and other input as required for Official Plans and Official Plan Amendments. Where a municipality has approval authority, the Regional Land Use Geologist participates in the Municipal Plan review directly with the municipality for Official Plan amendments and related planning initiatives.

In addition, reviews are completed, and information provided for pre-consultation for consent applications and formal consent applications, and plan of subdivision and/or condominium applications. Although such decisions are normally made by municipal governments, some areas of the southern region are outside of towns and cities. In the absence of a municipal government to manage planning decisions related to private land in those areas, decisions are made by the MMAH, with the support of partner ministries, including MINES.

In 2019, Ontario introduced "A Place to Grow: Growth Plan for the Greater Golden Horseshoe" (2019). The Growth Plan provides guidelines for designating areas in which population growth can be accommodated while maintaining protections for ecologically sensitive areas, agriculture, ground and surface waters, and mineral and aggregate resources. The Minister of Municipal Affairs and Housing required that municipalities revise their official plans to conform to the Growth Plan by July 1, 2022. Municipal official plans must be consistent with the Provincial Policy Statement 2020 and conform with any other Provincial and Regional Plans, including the Oak Ridges Moraine Conservation Plan (2017), the Greenbelt Plan (2017) and the Niagara Escarpment Plan (2017).

The requirement for conformity to the various plans by July 1, 2022 resulted in a high number of Official Plans being submitted to the southern Regional Land Use Geologist for review in 2021 and 2022. Many

Official Plans were updated through Official Plan amendments, which were included as "Draft Official Plans and Official Plan Updates" in Table 24, below.

In 2022, the southern Regional Land Use Geologist provided maps, comments and other input as required for municipal planning activities that included

- 106 consent (severance) and plan of subdivision and/or condominium applications in 22 lower-tier and 3 single-tier municipalities
- 30 Official Plans and related planning initiatives (such as Official Plan amendments, zoning by-laws, and minor variances) in 10 communities
- 25 new draft Official Plans or Official Plan updates

The municipalities involved in these planning initiatives are listed in Table 24. The southern Regional Land Use Geologist area (*see* Figure 10) overlaps with the Sudbury and Sault Ste. Marie (SSM) Resident Geologist districts. Townships and municipalities within the 2 northern districts that required input from the southern Regional Land Use Geologist in 2022 are identified with the district name in parentheses in the table below.

Table 24. Municipal planning initiatives with Regional Land Use Geologist input, southern Ontario, 2022. The home district of townships and municipalities located outside the Southern Ontario Region is shown in parentheses.

Consent (Severance) and Subdivision and/or Condominium Applications
Consent, Admaston, Township of Admaston–Bromley
Consent, Bagot, Township of Greater Madawaska (5)
Consent, Blithfield, Township of Greater Madawaska
Consent, Camden East, Township of Stone Mills (28)
Consent, Darling, Township of Lanark Highlands
Consent, Dungannon, Town of Bancroft
Consent, Elmsley, Township of Rideau Lakes (2)
Consent, Foley, Township of Seguin (Sudbury District)
Consent, Grattan, Township of Bonnechere Valley (3)
Consent, Head, Township of Head, Clara and Maria (Sudbury District)
Consent, Horton, Township of
Consent, Hungerford, Municipality of Tweed
Consent, Huntingdon, Municipality of Centre Hastings (2)
Consent, Lanark, Township of Lanark Highlands (3)
Consent, Lavant, Township of Lanark Highlands (2)
Consent, Marmora, Municipality of Marmora and Lake (2)
Consent, McNab, Township of McMab–Braeside
Consent, Monteagle, Municipality of Hastings Highlands (3)
Consent, North Burgess, Township of Tay Valley
Consent, North Crosby, Township of Rideau Lakes (3)
Consent, Oneida, Haldimand County
Consent, Papineau, Township of Papineau–Cameron (4) (Sudbury District)
Consent, Pembroke, Township of Laurentian Valley
Consent, Raglan, Township of Brudenell, Lyndoch and Raglan (2)
Consent, Ramsay, Township of Mississippi Mills
Consent, Ross, Township of Whitewater Region (2)
Consent, Seneca, Haldimand County
Consent, Sheffield, Township of Stone Mills (16)
Consent, South Burgess, Township of Rideau Lakes
Consent, South Crosby, Township of Rideau Lakes (2)
Consent, South Sherbrooke, Township of Tay Valley

Consent (Severance) and Subdivision and/or Condominium Applications
Consent, Township of Calvin (7) (Sudbury District)
Consent, Township of Horton
Consent, Township of Madoc
Plan of Subdivision, Herschel, Municipality of Hastings Highlands
Plan of Subdivision, North Crosby, Township of Rideau Lakes
Plan of Subdivision, Portland, Township of South Frontenac
Telecommunications facilities – Site Review, Township of Stone Mills (4)

Official Plans and Related Initiatives
Official Plan amendment, County of Haldimand (2)
Official Plan amendment, Region of Niagara (2)
Official Plan amendment, United Counties of Leeds and Grenville (2)
Zoning By-law amendment, Haldimand County (3)
Zoning By-law amendment, Township of Bonnechere Valley
Zoning By-law amendment, Township of Limerick
Zoning By-law amendment, Township of McNab–Braeside
Zoning By-law amendment, Township of Mississippi Mills (3)
Zoning By-law amendment, Township of Rideau Lakes (2)
Zoning By-law amendment, Township of Stone Mills (8)
Zoning By-law amendment, Township of Tay Valley
Minor variance, Township of Stone Mills (4)
Site plan control, Township of Mississippi Mills
Site plan control, Township of Stone Mills

Draft Official Plans and Official Plan Updates
Barrie, City of
Bonfield, Township of (Sudbury District)
Brockville, City of
Burk's Falls, Village of (Sudbury District)
Carling, Township of (Sudbury District)
Greater Napanee, Town of
Guelph, City of
Haldimand, County of
Hamilton, City of
Magnetawan, Municipality of (Sudbury District)
McDougall, Municipality of (Sudbury District)
Middlesex, County of
Niagara, Region of
Peterborough, County of
Prescott and Russell, United Counties of
Quinte West, City of
Seguin, Township of (Sudbury District)
Simcoe, County of
South Algonquin, Township of
St. Joseph Island (SSM District)
St. Mary's, Town of
Sundridge, Village of (Sudbury District)
Vaughan, City of
Wellington, County of
York, Region of

FIRST NATIONS

The southern Regional Land Use Geologist provides information on mineral occurrence sites, past and present mining and exploration activity, geology and mineral potential for land parcels being considered for addition to land claim areas for First Nations communities in southeastern Ontario. No new land claims or additions to existing land claims were received for southern Ontario in 2022.

Other Activities

The southern Regional Land Use Geologist also undertook other related work in 2022, as outlined below.

The northwest Regional Land Use Geologist began a six-month acting assignment with Earth Resources and Geoscience Mapping Section (ERGMS), OGS on August 9, 2021. The northwest duties were delegated to the northeast and southern Regional Land Use Geologists and the Land Use Planning and Policy Co-ordinator through February 2022.

Because of provincial government–mandated work-from-home directives, following public health restrictions that were implemented in response to the COVID-19 pandemic, Resident Geologist Program (RGP) staff continued to work remotely in 2022 until May 16, after which staff returned to the office for a minimum of 3 days per week for the remainder of the year. Field activities also resumed in May, allowing the Regional Land Use Geologist to accompany other staff of the Tweed office on 5 general interest field trips and 2 visits to active mineral exploration properties.

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 (www.ontario.ca/page/class-environmental-assessments-approved-class-ea-information), relating to 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 works with staff from MNRF and other ministries to ensure that relevant geoscience information and provincial mineral interests are identified and accommodated early in the planning process of projects subject to Class EAs.

There were no Class EA Reviews requiring input by the southern Regional Land Use Geologist in 2022.

SITE READINESS PROGRAM

The Ministry of Economic Development, Job Creation and Trade (MEDJCT) launched the Site Readiness Program in 2021 to provide municipalities and industrial landowners an opportunity to increase the development readiness of their industrial sites. The program complements the Investment Ready: Certified Site Program, providing a more streamlined process with a focus on smaller sites. Requests for comments were received for 9 Site Readiness applications in 8 communities in 2022, and are listed in Table 25.

Table 25. Site Readiness Applications submitted for Regional Land Use Geologist input, southern Ontario, 2022.

Site Readiness Applications
Town of Aylmer, Progress Drive, Malahide Township
Town of Aylmer, White Street, Malahide Township
Town of Walkerton, Municipality of Brockton
City of Brockville, Elizabethtown Township
Town of Ripley, Huron-Kinloss Township
Town of Lakeshore, Patillo Road, Maidstone Township
City of Port Colborne, Humberstone Township
City of St. Thomas, Edgeware Line, Malahide Township
City of Windsor, County Road 42, Sandwich Township

ENVIRONMENTAL REGISTRY

The Environmental Registry of Ontario (ERO) is an online resource that contains public notices about environmental matters being proposed by all Ontario government ministries covered by the Environmental Bill of Rights. The public notices contain information about proposals including new acts, regulations, policies and programs; plans to change or eliminate existing ones; and plans to issue permits for a wide range of activities across Ontario.

In 2022, most of the ERO postings relevant to southern Ontario were related to aggregate licences issued under the *Aggregate Resources Act*, notices of approval or amendments to Municipal Official Plans, and Provincial Park management, not requiring comments by the southern Regional Land Use Geologist.

Other significant issues posted on ERO were related to decisions on previously proposed amendments to the Greenbelt Plan and redesignation of lands under the Greenbelt Plan and the Oak Ridges Moraine Conservation Plan for housing development, in support of Bill 23, the *More Homes Built Faster Act*.

Province-wide ERO postings potentially affecting southern Ontario were related to amendments to the *Oil, Gas and Salt Resources Act* regarding regulation of compressed air storage in rock reservoirs and to *Planning Act* changes in support of Bill 23.

POLICY AND GUIDANCE

In October 2022, the Ministry of Municipal Affairs and Housing (MMAH) began a housing-focussed policy review of the Growth Plan for the Greater Golden Horseshoe: A Place to Grow (APTG) and the Provincial Policy Statement (PPS). Input from partner Ministries was requested on how to create a streamlined province-wide land use planning policy framework that enables municipalities to approve housing faster and increase housing supply.

The southern Regional Land Use Geologist, with the Land Use Planning and Policy Coordinator, provided comments for the MINES Strategic Policy Division on proposed changes to APTG and PPS, to be consolidated into a single MINES response to MMAH, stating that retaining policies that protect mineral and mineral aggregate supply, as well as retaining policies that require the identification and mitigation of mine hazards prior to any development within 1 km are essential.

In 2022, the Land Use Planning and Policy Coordinator had the opportunity to provide feedback for the Growing the Greenbelt - Amendments to Greenbelt Area Boundary Regulation and Greenbelt Plan. The Land Use Planning and Policy Coordinator provided review and feedback to MMAH for the policy review of A Place to Grow and the Provincial Policy Statement as well as the More Homes Built Faster: Ontario’s Housing Supply Action Plan 2022-2023.

Together, the Regional Land Use Geologist and the Land Use Planning and Policy Coordinator were able to participate in the OPS Biodiversity Network and learn more about the development and progress of the Ontario Biodiversity Council in renewing a biodiversity strategy for 2020–2030 and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.

CONFERENCES AND OUTREACH ACTIVITIES

In 2022, the southern Regional Land Use Geologist attended or participated in the following events:

In-Person:

- Prospectors and Developers Annual Convention, Toronto – assisted in staffing the Ontario booth and attended technical presentations
- Bancroft Rockhound Gemboree, Bancroft – assisted Tweed RGP staff in staffing a booth providing information about the mines of southern Ontario and the use of minerals in everyday life

Virtual meetings/conferences:

- Ontario Geological Survey, Open House: Regional-Scale Groundwater Geoscience in Southern Ontario – a series of presentations over 2 days by various government agencies, consultants and academia on groundwater science, programs and policies
- OPS Biodiversity Network – attended meetings and provided input on the process of developing a Strategic Biodiversity Policy for Ontario
- Ontario Geological Survey, Project Pulse – a series of technical presentation featuring project collaborations between OGS units such as the Earth Resources Geoscience Mapping Section and the Resident Geologist Program
- Ontario Geological Survey, Critical Minerals Strategy – technical presentations and program updates
- Ontario Geological Survey Virtual Showcase 2022 – a series of technical presentations over 3 days featuring results of geoscience projects in progress by the Ontario Geological Survey, summaries of activities in all Districts of the Resident Geologist Program, and updates on OGS data sets and online applications
- Kawartha Region Earth Sciences, Engineering and Metallurgy Network (KREEM) – monthly presentations and discussions on various aspects of geoscience, environment and engineering

MINERAL DEPOSIT COMPILATION GEOSCIENTIST ACTIVITIES—NORTHEASTERN ONTARIO

The Ontario Mineral Inventory (OMI), previously known as the Mineral Deposit Inventory (MDI), database is a dynamic compilation of over 19 100 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 (OGS), it provides additional tools for making mineral discoveries in Ontario.

In April 2021, the OGS Resident Geologist Program (RGP) initiated a project to add the MDI database to an existing intranet site that contained other RGP geoscience databases. This existing intranet site is called Ontario Mineral Exploration Information System (OMEIS). For more information on this migration and the reasoning behind it, *see* the 2021 Report of Activities (Mancini et al. 2022, p.59-60). This migration to a user-friendly database model allowed the Mineral Deposit Compilation Geoscientists (MDCG) to complete extensive data cleanup that was unfeasible in the previous system. Alongside data cleanup, regular updates of OMI entries were completed along with input of new occurrences.

The Mineral Deposit Compilation Geoscientists (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 OMI database is regularly updated. Regular updates are required to ensure that the Ministry of Mines is using the most up-to-date information in making land-use planning and policy decisions and that mineral industry clients have access to comprehensive and up-to-date records. Records for certain areas are reviewed and updated in support of bedrock mapping and other field work conducted by the Earth Resources and Geoscience Mapping Section (ERGMS) of the Ontario Geological Survey (OGS). For 2022, Sheree Hinz was the northeastern and southern Ontario MDCG.

Total contributions to the OMI database for northeastern and southern Ontario in 2022 included 13 242 updated records, 72 records deleted and 29 new records. A breakdown of the provincial records revised by district is provided in Table 26.

Table 26. Ontario Mineral Inventory records revision in northeastern and southern Ontario in 2022.

Resident or District Office	Updates	Deletions	New
Kirkland Lake	2489	0	5
Sault Ste Marie	1372	0	9
Southern Ontario	6166	56	5
Sudbury	1516	16	2
Timmins	1699	0	8
Total	**13 242**	**72**	**29**

GEOGRAPHIC INFORMATION SYSTEM DATA SPECIALIST ACTIVITIES—NORTHWESTERN AND NORTHEASTERN ONTARIO

The Resident Geologist Program's Geographic Information System (GIS) Data Specialist positions are currently based in the Thunder Bay and Tweed offices and serve the northwest and, northeast and southern RGP regions respectively. During 2022, the Thunder Bay position was occupied by Genevieve Dorland. The Tweed position was filled by Lucas Beckering Vinckers-Stofer between February and June. Nazha Sabiri moved into the Tweed position on an interim basis in July and assumed the role permanently in September. The GIS Data Specialists create maps and graphics, manage geospatial data and conduct data analysis for land-use planning purposes, geoscience compilations, reports, posters and presentations. They provide ongoing GIS support to the Resident Geologist Program (RGP) and respond to client requests for assistance with accessing geoscience data.

Existing Data Products

ONTARIO ASSESSMENT FILE DATABASE AND ONTARIO DRILL HOLE DATABASE

The Ontario Assessment File Database (OAFD), Ontario Drill Hole Database (ODHD) and Ontario Mineral Inventory (OMI) are updated on a continual basis by RGP staff using the Ontario Mineral Exploration Information System (OMEIS). An intranet-based application, OMEIS was launched in 2018 and is used by RGP and Mining Lands staff to maintain and update assessment file and drill-hole data. New assessment files and related drill holes are added to the database as soon as the files are received from Mining Lands. Updates to existing data are made on an ongoing basis. These updates can include corrections to address errors reported by clients or other Ministry of Mines (MINES) staff, or improvements, such as the addition of details that had not been captured for older files. Updated information and new files are accessible through the GeologyOntario search tool within 24 hours. Most of the data entry is carried out by the District Geological Assistants. The GIS Data Specialists are responsible for the administration of OMEIS, the creation of GIS data for the new files and drill holes as well as corrections to existing assessment file polygons. The GIS Data Specialists extract the tabular and spatial data at the beginning of each month and compile it for release as both 1) a graphical interface or data layer (keyhole mark-up language (*.kml*) file) through OGSEarth (www.ontario.ca/ogsearth) which can be viewed using geographic information applications, such as Google Earth™ mapping service; and 2) a compressed (*.zip*) downloadable file on GeologyOntario (www.hub.geologyontario.mines.gov.on.ca). A summary of new items added, and existing items updated in 2022 is provided in Table 27.

Table 27. Ontario Mineral Exploration Information System (OMEIS) statistics for 2022.

File Type	New Files Added	Existing Files Updated	New Drill Holes Added	Existing Drill Holes Updated
Approved Assessment	517	27 120	2849	557
Non-Assessment Exploration Work	0	557	80	2
Total	**517**	**27 677**	**2929**	**559**

**Data cleanup was carried out on a large number of assessment file records.*

New Data Products

CRITICAL MINERALS LAYER

The GIS Data Specialists were involved in the development of the Critical Minerals layer for OGSEarth. This new data set allows users to view mineral inventory locations that have critical minerals as primary or secondary commodities. The points are categorized by commodity and include links to view the full description of the features on GeologyOntario. The Critical Minerals layer can be downloaded on the OGSEarth Web site (www.hub.geologyontario.mines.gov.on.ca) and is updated monthly to include new and updated mineral inventory locations.

Other Projects

UPGRADES TO GEOLOGYONTARIO

In 2022, the project to create a spatial search tool and upgrade the text search for GeologyOntario continued. The GIS Data Specialists were part of the project team, helping to translate the results of user research into spatial search tool features and providing advice on the functionality of the text search.

ACKNOWLEDGMENTS

The authors would like to thank Dawn-Ann Metsaranta, Northeast Manager of the Resident Geologist Program for her support throughout the year as well as reviewing and editing of this report. Thank you to Marg Rutka, Monica Gaiswinkler Easton and their colleagues from the Publications Services Unit, Ontario Geological Survey for their assistance, reviews, edits and bringing this report to publication.

The authors would like to thank all producers, exploration companies, prospectors and developers who provided access to their operations or supplied information throughout 2022. Strong communication links between stakeholder groups and government ministries are essential for effective program delivery and, ultimately, to improve the delivery of government services.

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Ontario

Ministry of Natural Resources and Forestry
Integration Branch

Petroleum Operations Section—2022

by

L. Fortner

2023

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Petroleum Operations Section—2022

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SUMMARY OF ACTIVITY

As regulated under the *Oil, Gas and Salt Resources Act* (OGSRA), the recent activity in Ontario has been very different than it was in past decades when there may have been approximately 100 wells drilled in a year. In 2020, there were no new wells drilled of any type. In 2021, 4 new wells were drilled, with 3 being gas storage wells. The total number of wells drilled increased significantly in 2022, to 21, although only 6 were not stratigraphic tests.

Because of the current lack of petroleum exploration and development information, drilling and licencing activity under the *Oil, Gas and Salt Resources Act* during 2022 is provided in Tables 1, 2 and 3.

Table 1. New wells drilled in 2022.

Licence Number	Well Type	Well Mode	Total Depth (m)	Total Depth Date	County	Township
T012646	Oil and Gas Well	Potential	242.0	August 4, 2022	Elgin	Aldborough
T012668	Gas Show	Potential	1226.0	October 18, 2022	Lambton	Enniskillen
T012647	Natural Gas Storage Well	Active	683.8	June 3, 2022	Lambton	Moore
T012638	Natural Gas Storage Well	Active	779.5	June 20, 2022	Lambton	Moore
T012648	Observation Well	Active	603.2	July 4, 2022	Lambton	Sombra
T012667	Observation Well	Active	1100.0	September 30, 2022	Haldimand	Walpole
T012649	Stratigraphic Test	Abandoned	53.0	May 29, 2022	Durham	Lake Ontario
T012656	Stratigraphic Test	Abandoned	70.3	June 4, 2022	Durham	Lake Ontario
T012654	Stratigraphic Test	Abandoned	71.5	June 14, 2022	Durham	Lake Ontario
T012651	Stratigraphic Test	Abandoned	71.4	June 19, 2022	Durham	Lake Ontario
T012653	Stratigraphic Test	Abandoned	61.6	July 6, 2022	Durham	Lake Ontario
T012657	Stratigraphic Test	Abandoned	61.0	July 7, 2022	Durham	Lake Ontario
T012652	Stratigraphic Test	Abandoned	63.4	July 17, 2022	Durham	Lake Ontario
T012658	Stratigraphic Test	Abandoned	68.7	July 31, 2022	Durham	Lake Ontario
T012663	Stratigraphic Test	Abandoned	61.8	August 4, 2022	Durham	Lake Ontario
T012650	Stratigraphic Test	Abandoned	60.9	August 9, 2022	Durham	Lake Ontario
T012662	Stratigraphic Test	Abandoned	62.0	August 17, 2022	Durham	Lake Ontario
T012665	Stratigraphic Test	Abandoned	60.9	August 18, 2022	Durham	Lake Ontario
T012669	Stratigraphic Test	Abandoned	60.6	September 2, 2022	Durham	Lake Ontario
T012664	Stratigraphic Test	Abandoned	70.4	September 10, 2022	Durham	Lake Ontario
T012655	Stratigraphic Test	Abandoned	60.6	September 24, 2022	Durham	Lake Ontario

Table 2. Licences issued in 2022 to plug or operate existing wells.

Licence Number	Well Type	County	Township
T012680	Gas Show	Norfolk	North Walsingham
T012671	Gas Well Oil Show	Haldimand	Walpole
T012661	Licensed	Kent	Romney
T012686	Natural Gas Well	Haldimand	North Cayuga
T012639	Observation Well	Kent	Romney
T012641	Oil Well	Lambton	Brooke
T012677	Oil Well	Lambton	Enniskillen
T012659	Private Gas Well	Kent	Romney
T012681	Private Gas Well	Welland	Wainfleet

Table 3. Licences issued in 2022 to drill new wells.

Licence Number	Purpose	Total Depth Date	Well Mode	County	Township
T012670	Brine Well	–	Not Drilled	Lambton	Sarnia
T012647	Natural Gas Storage Well	June 3, 2022	Active Well	Lambton	Moore
T012638	Natural Gas Storage Well	June 20, 2022	Active Well	Lambton	Moore
T012645	Natural Gas Storage Well	–	Not Drilled	Lambton	Moore
T012660	Natural Gas Storage Well	–	Not Drilled	Lambton	Moore
T012678	Natural Gas Storage Well	–	Not Drilled	Welland	Humberstone
T012675	Natural Gas Well	–	Not Drilled	Oxford	Blenheim
T012676	Natural Gas Well	–	Not Drilled	Oxford	Blenheim
T012667	Observation Well	–	Active Well	Haldimand	Walpole
T012648	Observation Well	July 4, 2022	Active Well	Lambton	Sombra
T012683	Oil and Gas Well	–	Not Drilled	Elgin	Aldborough
T012646	Oil and Gas Well	August 4, 2022	Potential	Elgin	Aldborough
T012679	Oil and Gas Well	–	Not Drilled	Elgin	Dunwich
T012643	Oil and Gas Well	–	Potential	Elgin	Dunwich
T012668	Oil and Gas Well	October 18, 2022	Active Well	Lambton	Enniskillen
T012644	Oil and Gas Well	–	Not Drilled	Lambton	Enniskillen
T012642	Oil Well	–	Not Drilled	Essex	Rochester
T012640	Oil Well	–	Not Drilled	Kent	Dover
T012685	Oil Well	–	Not Drilled	Kent	Raleigh
T012666	Private Gas Well	–	Not Drilled	Lincoln	Caistor
T012684	Private Gas Well	–	Not Drilled	Welland	Humberstone
T012672	Solution Mining Well	–	Not Drilled	Essex	Sandwich West
T012673	Solution Mining Well	–	Not Drilled	Essex	Sandwich West
T012674	Solution Mining Well	–	Not Drilled	Essex	Sandwich West
T012658	Stratigraphic Test	August 23, 2022	Abandoned	Durham	Lake Ontario
T012649	Stratigraphic Test	–	Abandoned	Durham	Lake Ontario
T012650	Stratigraphic Test	–	Abandoned	Durham	Lake Ontario
T012651	Stratigraphic Test	–	Abandoned	Durham	Lake Ontario
T012653	Stratigraphic Test	–	Abandoned	Durham	Lake Ontario
T012654	Stratigraphic Test	–	Abandoned	Durham	Lake Ontario
T012656	Stratigraphic Test	–	Abandoned	Durham	Lake Ontario
T012657	Stratigraphic Test	–	Abandoned	Durham	Lake Ontario
T012662	Stratigraphic Test	–	Abandoned	Durham	Lake Ontario
T012663	Stratigraphic Test	–	Abandoned	Durham	Lake Ontario
T012665	Stratigraphic Test	–	Abandoned	Durham	Lake Ontario
T012652	Stratigraphic Test	–	Not Drilled	Durham	Lake Ontario
T012655	Stratigraphic Test	–	Not Drilled	Durham	Lake Ontario
T012664	Stratigraphic Test	–	Not Drilled	Durham	Lake Ontario
T012669	Stratigraphic Test	–	Not Drilled	Durham	Lake Ontario

***Note**: "–" indicates total depth not recorded in Ontario Petroleum Data System (OPDS) as of March 1, 2023.*

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.*

ISSN 1484-9402 (print)
ISBN 978-1-4868-6797-4 (print)

ISSN 1916-6168 (online)
ISBN 978-1-4868-6798-1 (PDF)