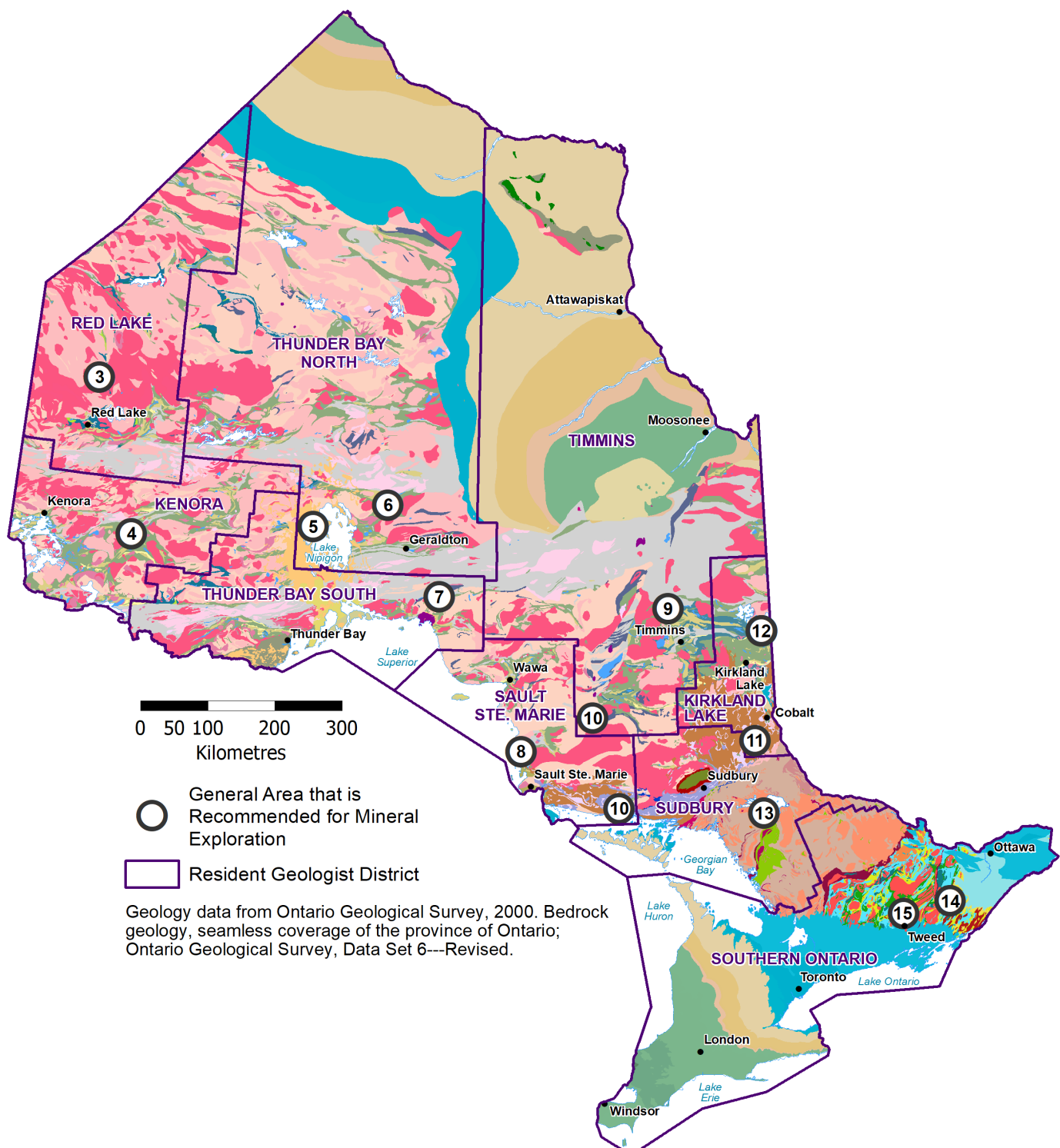


Recommendations for Exploration 2020–2021



Ministry of Energy, Northern Development and Mines
Ontario Geological Survey - Resident Geologist Program

Recommendations for Exploration 2020–2021



Ontario Geological Survey

Resident Geologist Program

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The Ontario Geological Survey is pleased to issue its 2021 Recommendations for Exploration. These recommendations are the product of the Ministry of Energy, Northern Development and Mines' dedicated and knowledgeable staff located across the province.

Each year, recommendations are developed based on the wealth of geological and exploration data available to our staff (and you) and any new information or concepts derived from the current year's activities.

Please review our current recommendations and feel free to discuss these in detail with any of our geoscientists.

Visit OGSEarth on the Ministry's Mines and Minerals Division Web site (www.ontario.ca/ogsearth) to see what else is available.

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About the Resident Geologist Program

Resident Geologists are the stewards of public geological and mineral exploration information for their districts. They provide a broad range of advisory services on geological topics of interest to the public, to municipal governments and to the mineral industry.

They are the local experts on why geoscience information is important, what information is available and what is happening in exploration.

The program provides primary client services through a network of 8 field offices strategically located across the province.

Our services include

- collecting and maintaining geological data
- monitoring exploration activity
- conducting property examinations
- providing geological and exploration advice

We provide geoscience information to support

- public safety
- environmental planning
- land use planning
- mineral sector investment and economic development

We provide information and training to First Nation Communities regarding prospecting, mineral exploration and mining.

For more information about the Resident Geologist Program please visit the Mines and Minerals Division Web site at www.mndm.gov.on.ca/en/mines-and-minerals/geology#simple-table-of-contents-2.

Users of OGS products should be aware that Indigenous communities may have Aboriginal or treaty rights or other interests that overlap with areas of mineral potential and exploration

HIGHLIGHTS



- Underexplored despite high demand in the Electric Vehicle industry
- Good potential for lithium in Chambers Township
- Excellent metasedimentary host proximal to a potential “fertile” parental granite

Lithium-Cesium-Tantalum (LCT) Pegmatite Potential in the Temagami Area

Cynthia–Chambers–Strathy is a block of 3 contiguous townships within the Temagami Greenstone Belt (TGB) which is itself located approximately 40 km north of the Grenville Province in eastern Ontario. For further description of the TGB, the reader is referred to Moorhouse (1946), Bennett (1978) and Fyon and Cole (1989).

In Chambers Township, Archean mafic to intermediate to felsic and metasedimentary rocks are intruded by the Spawning Lake quartz monzonite stock in the south, and the Chambers–Strathy batholith in the north. Proterozoic Cobalt Group sedimentary rocks unconformably overlie the rocks in the northwest corner of the township. Younger Nipissing diabase dikes and sills intrude all the rocks in the area. Selected mineral occurrences in the area are the R.G. Gilson (copper, zinc, lead, gold) occurrence, the Kokoko (iron) prospect and the Falconbridge DDH CHA-03 (nickel, copper) occurrence in Chambers; the Falconbridge DDH CHA-08 (zinc, copper, lead) occurrence, and the B. Westin (gold) occurrence in the adjacent townships of Cynthia and Strathy, respectively (Figure 1).

The Temagami area remains underexplored for LCT mineralization despite high demand in the electric vehicle industry. In this article, the author aims at highlighting some of the significant characteristics of this class of pegmatite, and how they can be harnessed to help guide exploration efforts in Chambers Township.

LCT pegmatites are granitic rocks that form relatively small igneous bodies and are characterized by large crystals and unique textures, particularly graphic intergrowths (London 2008). The LCT family of pegmatites takes its name from its characteristic enrichment in lithium, cesium, and tantalum, thus, in addition to the lithium minerals petalite, lepidolite, and spodumene, LCT pegmatites may contain the cesium ore mineral, pollucite; the tantalum ore mineral, columbite-tantalite; the beryllium ore mineral, beryl; and the tin ore mineral, cassiterite. LCT pegmatites are the products of extreme fractional crystallization of orogenic granites. Most such granites were derived from metasedimentary rocks (S-type granites) rich in muscovite although certain LCT pegmatites are related to granites derived from igneous rocks (I-type granites) (Martin and De Vito 2005; Bradley et al. 2017).

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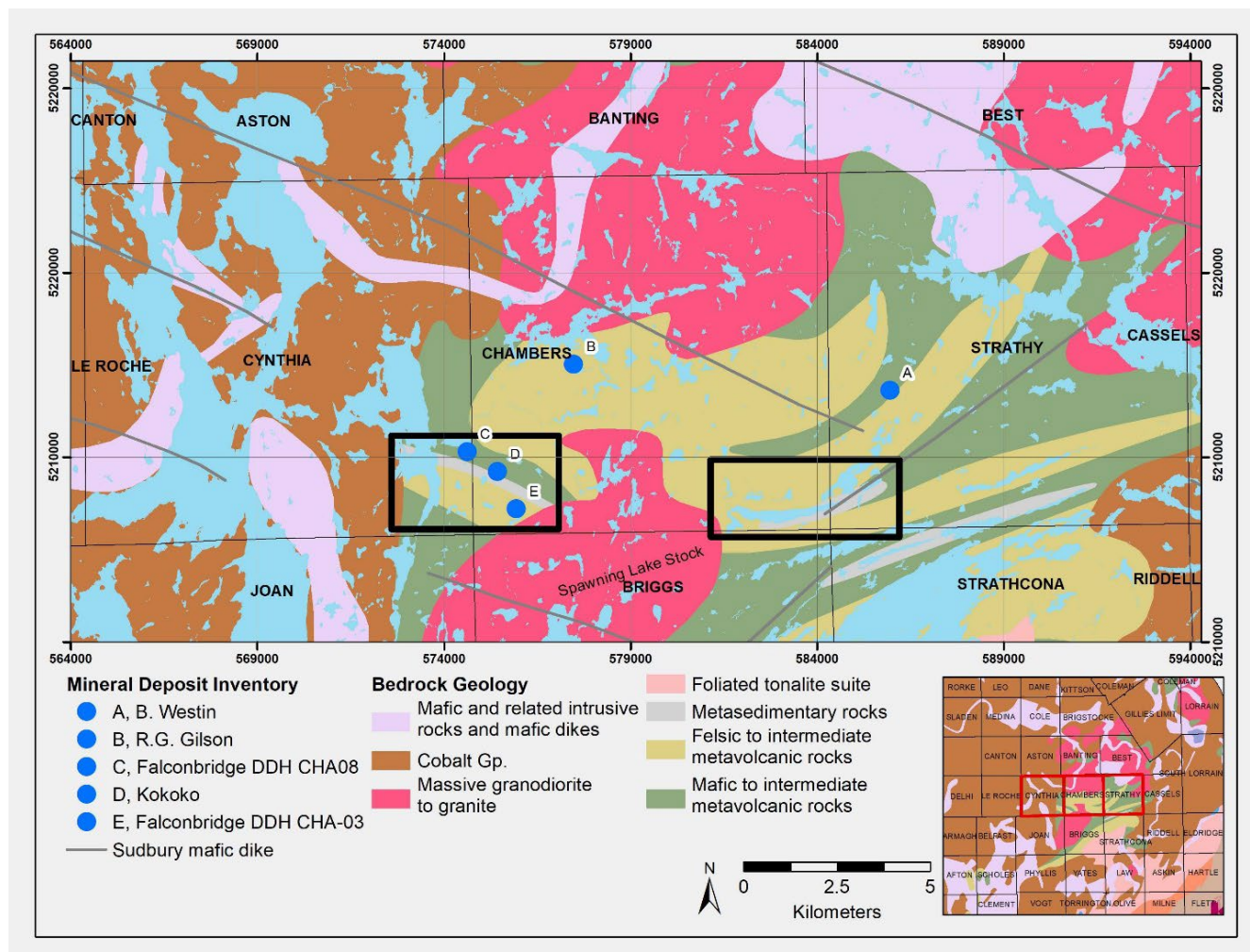


Figure 1. Geology map showing Chambers and surrounding townships, with the locations of selected occurrences from the Mineral Deposit Inventory database (Ontario Geological Survey 2020). The inset township map shows the entire Temagami greenstone belt. Geology from Ontario Geological Survey 2011. Universal Transverse Mercator (UTM) co-ordinates are provided using North American Datum 1983 (NAD83) in Zone 17.

The following factors and considerations are important regarding mineralization and exploration for LCT pegmatites in Chambers Township:

- The most significant change in LCT pegmatites through Earth's history is that, by far, the largest deposits are Archean in age. Thus, the potential for economic deposits seems greatest in orogens of that age (Bradley and McCauley 2013). This factor is satisfied by Chambers and the TGB in general.
- Most LCT pegmatites intruded and are hosted in metamorphosed sedimentary rocks, typically at low pressure amphibolite to upper greenschist facies (Černý 1992). Bradley and McCauley (2013) add that the metamorphic grade setting is a guide rather than a requirement. In Chambers Township, metasedimentary and metavolcanic rock units are in contact with and in close vicinity (approximately 1 km) of the granitic Spawning Lake stock (see rectangular blocks in Figure 1). The Spawning Lake stock is a large body of porphyritic quartz monzonite. It consists of 2 distinct phases: a central coarse porphyritic phase and a medium-grained grey border phase. Narrow dikes of aplite and pegmatite are locally abundant. The central coarse porphyritic phase makes up, by far, the largest part of the stock (Bennett 1978).

- It is relevant to ascertain whether the Spawning Lake stock is “fertile”. Fertile granites are identified by the presence of distinctive minerals, such as muscovite, tourmaline, and garnet; by anomalously high concentrations of such trace elements as lithium, cesium, tantalum, rubidium and tin; and by low concentrations of major elements calcium, iron, and magnesium (Selway et al. 2005). Around a fertile granite, the more distal LCT pegmatites are more likely to be enriched in lithium and other compatible elements (Figure 2).
- Weathering of LCT pegmatites can result in both soil anomalies and indicator minerals. Smith and others (1987) demonstrated that arsenic, beryllium, antimony, and tin form a 12 by 20 km halo in lateritic soils around the Greenbushes pegmatite in western Australia, whilst niobium, tantalum, and boron form a smaller, 1 by 5 km halo. Cassiterite, tantalite, elbaite, and spessartine are sufficiently dense and durable to serve as heavy indicator minerals that can be found by panning unconsolidated sediments (Bradley et al. 2017).

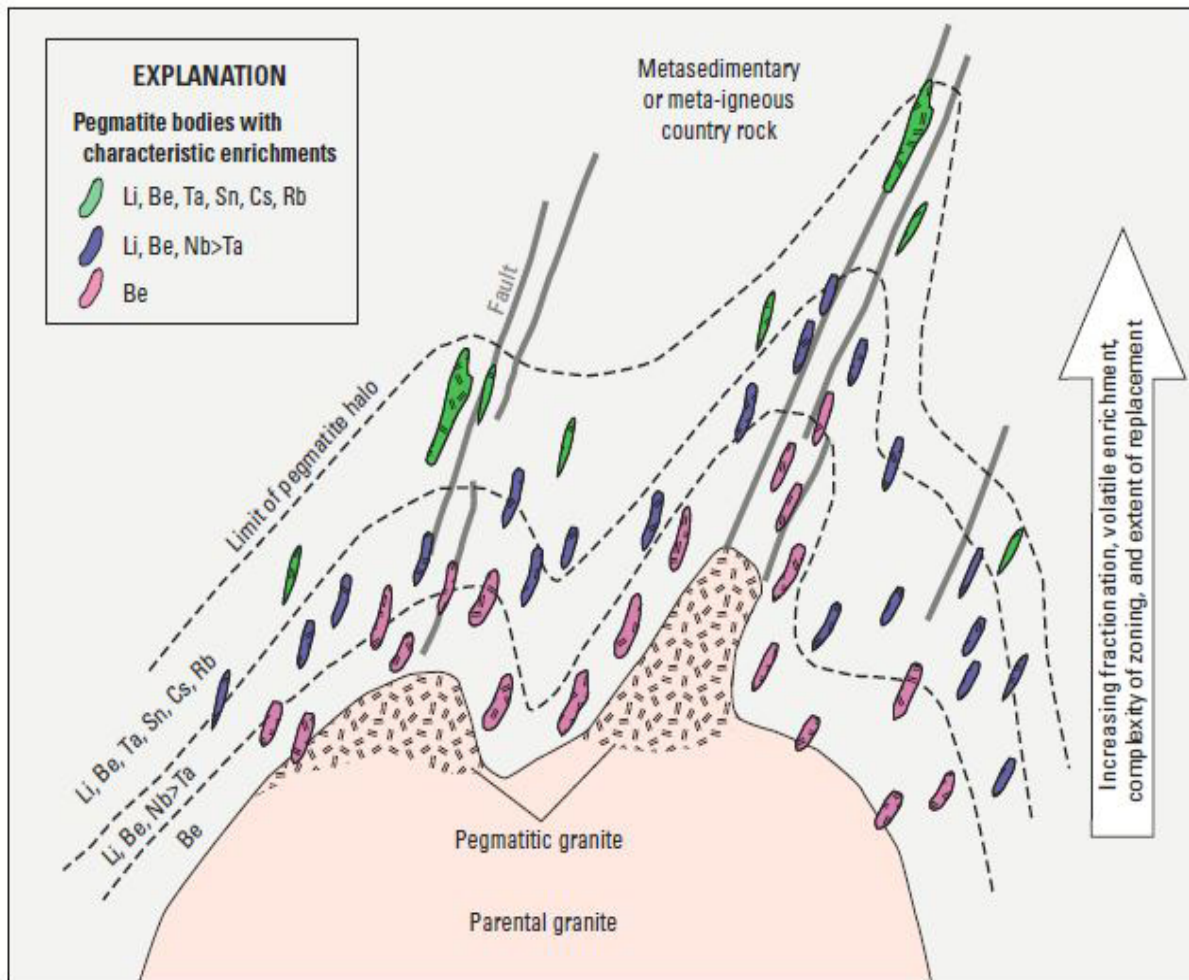


Figure 2. Schematic cross section showing the concentric arrangement of LCT pegmatites (small pink, purple, and green bodies) around a parental granite pluton. In this model, common pegmatites form near the parent, whereas pegmatites with enrichments in incompatible elements (indicated by chemical symbols) and corresponding rare minerals form farther away. Be = beryllium; Cs = cesium; Li = lithium; Nb = niobium; Rb = rubidium; Sn = tin; Ta = tantalum. Diagram *modified from* Bradley et al. (2017).

In summary, historical exploration for LCT pegmatites in the Temagami area is unknown. Chambers Township is located within the Temagami granite–greenstone belt which has undergone regional greenschist to low amphibolite facies metamorphism. Based on these characteristics and the above factors and considerations which are consonant with Superior Province-type rare metal pegmatite deposit model, one might suggest that Chambers Township has the potential to host LCT pegmatites. Against this backdrop, 2 rectangular areas (see Figure 1) containing lensoidal metasedimentary rock units proximal to a potential fertile granitic Spawning Lake stock are recommended for the exploration of these critical metals. An exploration program consisting of detailed geological mapping and sampling of any existing distal pegmatitic dikes should be implemented as an initial approach, followed by soil geochemical survey and sampling to delineate potential metal anomalies and zones.

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