# Precious and Base Metal Deposits of the Abitibi Greenstone Belt

**MUN-SEG 2024 Field Trip Report**
**April 28th - May 5th, 2024**

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## Sponsors

We wish to express our sincere gratitude to our sponsors who made this field trip possible. Funding was received from the **Society of Economic Geologists** (Stewart R. Wallace Fund), the **Prospectors and Developers Association of Canada** (student field trip funding program), and several generous local industry sponsors. In alphabetical order, these were: **Anteros Metals, Exploits Discovery, Newfound gold, and United Gold**.

# Overview

The goal of this field trip was to expose students to a wide range of precious and base metal deposits within the Abitibi greenstone belt in Ontario and Quebec. The Abitibi greenstone belt represents one of the largest, and best preserved Archean greenstone belts on Earth and is host to the prolific Abitibi gold belt. This field trip provided students with the opportunity to study a variety of gold and base metal deposits and to gain hands-on experience and insight from local experts to better understand the local geology, mineralogy/mineralization, mining techniques, and environmental issues within each of the different mineral deposits. Students were able to apply any information learned during the proposed field trip to their ongoing geological research and throughout their future careers as aspiring geoscientists. This field trip will ultimately provide students from MUN-SEG to learn about historical, current, and future mining operations within the Abitibi greenstone belt while also offering an excellent opportunity to learn about ongoing social, political, and environmental challenges faced by Canadian mining companies. Furthermore, students were given the opportunity to socialise and build professional relationships with members of the Laurentian University's SEG chapter as well as local academic and industry professionals.

# Itinerary

**April 28th:** Travel day (St. John's-Toronto-Sudbury)

***Day 1*** *(April 29th):* Sudbury basin tour with the Ontario Geological Survey.

***Day 2*** *(April 30th):* Underground tour at Totten Mine (Vale) and geostops around Kirkland Lake.

***Day 3*** *(May 1st):* Morning open pit tour at Hollinger and Dome mines (Newmont) and afternoon tour of the Kam Kotia remediation site with the Ontario Geological Survey.

***Day 4*** *(May 2nd)***:** Presentation and tour of the Horne 5 project site (Falco Resources) in Rouyn-Noranda, Quebec.

***Day 5*** *(May 3rd)***:** Presentation and tour of the LaRonde project site (Agnico Eagle) and the Musée Minéralogique de l'Abitibi Témiscamingue in Malartic.

***Day 6*** *(May 4th):* Visit to the town of Cobalt to see historical mining works.

**May 5th:** Travel day (North Bay-Toronto-St. John's)

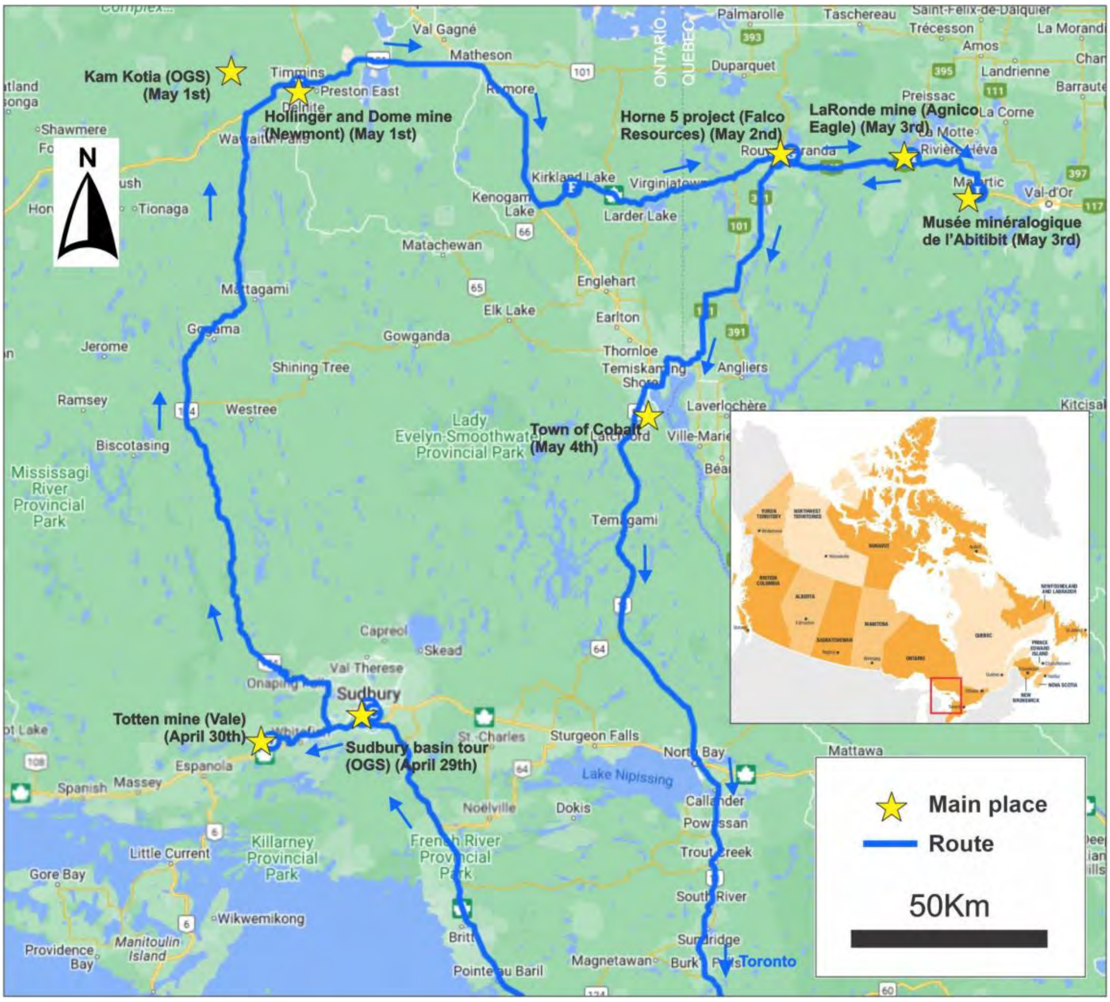


**Figure 1.** Location of the main places visited in the MUN-SEG 2024 Field Trip.

# Daily Summaries

## ***Day 1:*** *Sudbury impact basin tour (OGS)*

Upon arriving in Sudbury we were greeted by Shirley Peloquin and Bailey McKinnon of the Ontario Geological Survey. We spent the day driving across the Sudbury basin and stopping at key outcrops including shatter cones (Fig. 2), the Sudbury discovery site where stringer sulphides are exposed (Fig. 3A), igneous rocks from the Sudbury Igneous Complex interpreted as a product of magma differentiation after the impact (Fig. 3B-C), gneisses cutting by impacted-generated Subdury Breccia veinlets and thin dikes (Fig. 3D), supracrustal and chemical basin-filled sequence of the Whitewater Group (Fig. 3E).

In the evening, we connected with students from the SEG chapter at Laurentian University. It was a valuable networking opportunity where we exchanged experiences and insights from our respective student chapters.

**Figure 2.** MUN-SEG students and Shirley Peloquin pictured in front of shatter cones.

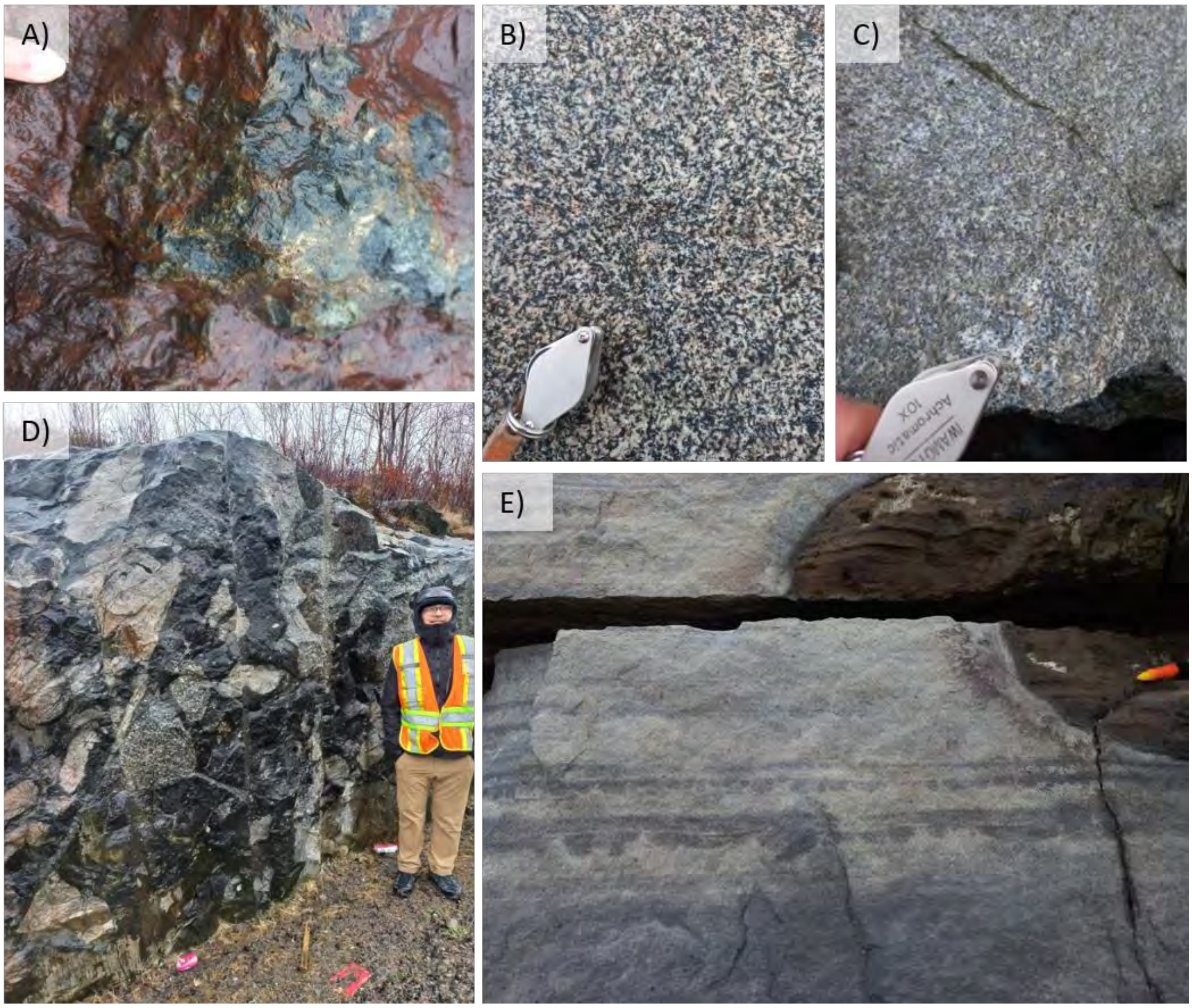


**Figure 3.** Outcrop photos: A) stringer sulphides in the Sudbury Discovery Site; B) Gabbro with feldspar; C) Equigranular massive Norite; D) Polymictic Subdury Breccia - Pseudotachyllite; E) Bouma sequence with flame structures in the Bedded Chelmsford Formation.

**Figure 4.** MUN-SEG students at discovery site of the Sudbury nickel deposits.

## **Day 2:** *Totten mine (Vale) and geostops around Kirkland lake*

On our second day in Sudbury we visited the underground Totten mine owned by Vale. The mineralization at Totten Mine is associated with a Cu-Ni-PGE sulfide deposit formed through three key processes: pre-existing sulfide mineralization, a massive meteorite impact that generated crustal melt, and high concentration of sulphides during differentiation.

We were greeted by Kathleen McDonald and Aminat Popoola who kindly gave us the tour. Our morning consisted of attending a daily safety meeting, receiving our PPE, and watching underground safety videos. Later in the day we travelled over a kilometre underground (Fig. 5) and shadowed Kathleen and Aminat as they performed their daily tasks, including stope inspection and measurement, visiting drills, and viewing core (Fig. 6). We also had the opportunity to discuss the nuances of underground drilling with a drill crew during our time below surface.

In the afternoon, we visited some key outcrops including the gold-bearing quartz veins in the Mile of Gold Stature, the discovery outcrop where prospectors initially found gold in Kirkland lake (Fig. 7), the altered leucitite outcrop, and carbonate- and fuchsite-altered komatiites (Fig. 8).

**Figure 5.** MUN-SEG student in the underground Totten mine.


**Figure 6.** High-grade Ni-Cu-PGE drill core in the underground Totten mine.

**Figure 7.** Altered leucitite at crystal lake and the discovery outcrop.

**Figure 8.** Green carbonate-clay altered komatiite within the Cadillac-Larder Lake Fault zone.

## ***Day 3:*** *Hollinger and Dome mines (Newmont) and Kam Kotia remediation site*

Early in the morning, the group visited the Hollinger and Dome mines operated by Newmont Goldcorp. The mine itself is located within the Timmins-Porcupine Gold Camp, an area with an extensive history of gold mining. The geology of the camp is complex, with several generations of folding, faulting, and shearing that have created numerous structural traps for gold mineralization. The Hollinger deposit is associated with the Porcupine-Destor Fault Zone, a major regional structure that has played a crucial role in localising gold mineralization. Peter Harvey and Justin George, geologists from Newmont, received us on site and provided an overview of regional and local geology with focus on key structural and mineralizing events. We then headed for a tour through the Hollinger and the Dome pits. During the tour we were also introduced to the mine's geotechnical monitoring system which continuously scans the pit walls for unplanned movement. The Hollinger pit has been in continuous production since the early 1900's and has produced more than 30 Moz of gold during its lifetime. The Dome pit has produced more than 15 Moz Au. After the tour, we met with Newmont's geology and engineering team at their on-site office and learned about their experiences working at an open pit mine.

In the afternoon, we met with resident geologist Matt Krukowski and the rehabilitation officers of the Ontario Geological survey who provided a tour of the Kam Kotia remediation mine site (Fig. 9). Kam Kotia is a former Cu-Zn VMS mine that operated from 1943-1944 and from 1961-1972. During its operation, the mine generated about 6 million tons of unmanaged tailings that covered more than 500 hectares. Acid mine drainage eventually became a serious issue to local waterways and led to one of the worst environmental disasters in Ontario's history. Remediation process began in 2001 with the construction of a treatment plant, relocation of tailings, and capping of specific areas to avoid further damage. Ongoing remediation efforts have led to drastic improvements in water quality (pH, dissolved metals, etc.), however ongoing work is still necessary to prevent future acid mine drainage.

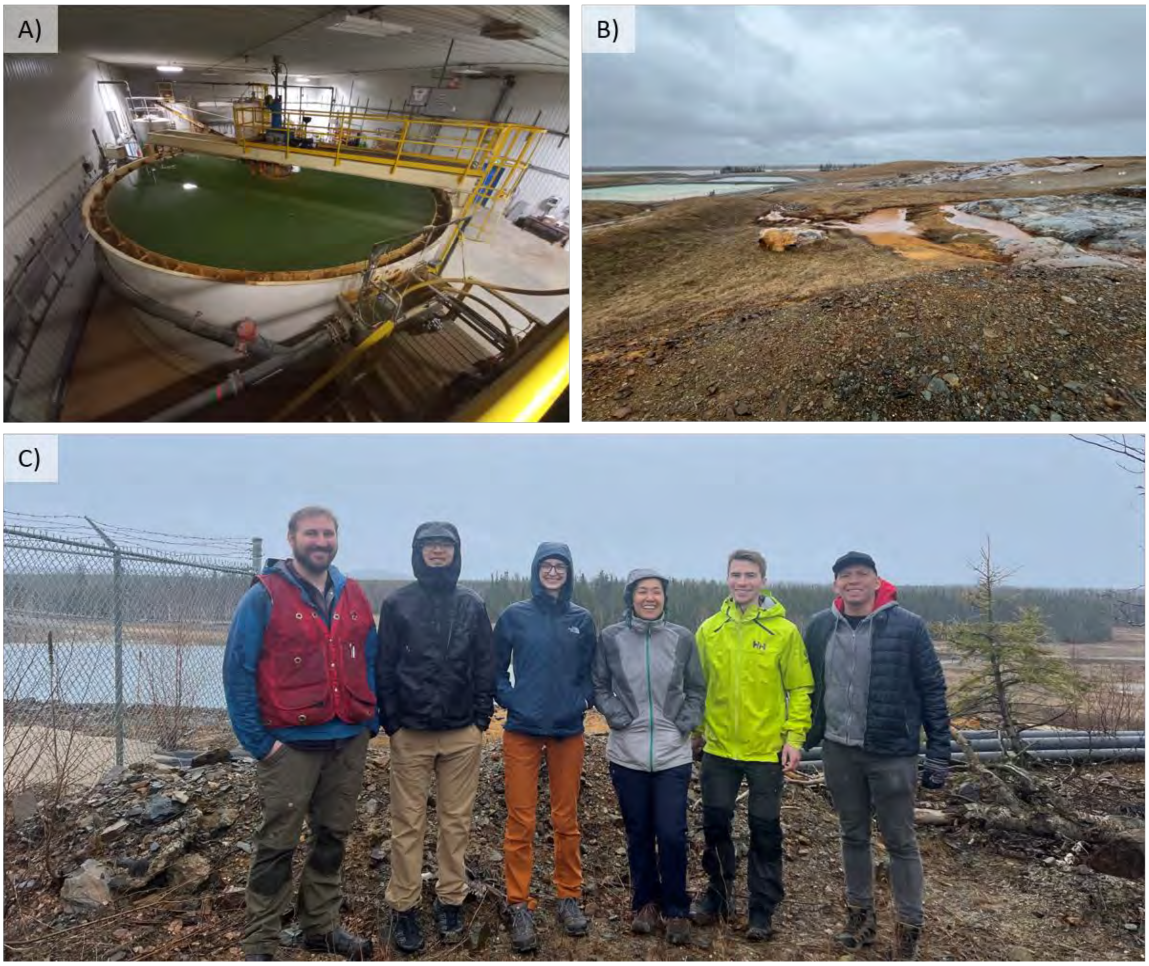


**Figure 9.** Kam Kotia remediation site. A) Treatment plant; B) Acid tailings; C) MUN-SEG students and resident geologist Matt Krukowski.

## **Day 4:** *Horne 5 project (Falco Resources)*

After a busy day in Timmins we headed to Rouyn-Noranda, Quebec. Our first stop was a tour of the Horne 5 project owned by Falco Resources. Horne 5 project is located within the Noranda mining camp, one of the most prolific VMS mining districts in Canada. The Horn 5 project is a continuation of the historic Horne mine which was operated by Noranda from 1926 to 1976. The Horne 5 project is currently in the advanced stages of mine planning and provided us with an informative opportunity to learn about nuances of the transition from planning to mine operation. The ore body is massive and vertically oriented. Mineralization is predominantly pyrite and pyrrhotite with lesser chalcopyrite, magnetite, and sphalerite; native gold and Au-Ag telluride minerals also occur (Fig. 10).


**Figure 10.** A) and B) Drill cores with copper and gold high-grade mineralization; C) MUN-SEG students and Claude Pilote pictured at the Horne 5 site.

We were greeted by Claude Pilote and Francis Gonthier who gave us a presentation and tour of their site. We discussed the history and geology of the deposit and plans for the new Horne 5 mine, including the processes of opening and closing a mine. Next, we were given a tour of their site, visited new infrastructure as well as old mine workings, and finished the tour with a core viewing.

## **Day 5:** *LaRonde mine (Agnico Eagle) and musée minéralogique de l'Abitibi Témiscamingue*

On our second day in Quebec we headed east from Rouyn-Noranda for a tour of the LaRonde deposit, currently owned and operated by Agnico Eagle. The mine has been in operation since 1988. LaRonde is a gold-rich VMS deposit with mineralization occuring in five zones consisting of massive and disseminated sulfide lenses (Fig. 11). The sulfides are predominantly chalcopyrite and sphalerite, and they are rich in Au, Cu, Zn, and Ag. We were welcomed by the senior geologist David Pitre, who gave us a presentation, guided us through some nearby outcrops, and showed us mineralized drill cores (Fig. 12). He also demonstrated useful techniques for recognizing minerals like kyanite (Fig. 13).

After the mine tour at LaRonde, we went to the Musée Minéralogique de l'Abitibi Témiscamingue in Malartic. This museum presents a permanent exhibition of the regional geology and mining projects in the area. It showcases unique specimens, including high-grade gold samples and exceptional mineral samples, as well as old mineral exploration techniques.

**Figure 11.** Hand samples with massive galena and pyrite, and pyrite nodules in a sedimentary rock.

**Figure 12.** David Petri explains to us the main mineralogy in the LaRonde deposit.

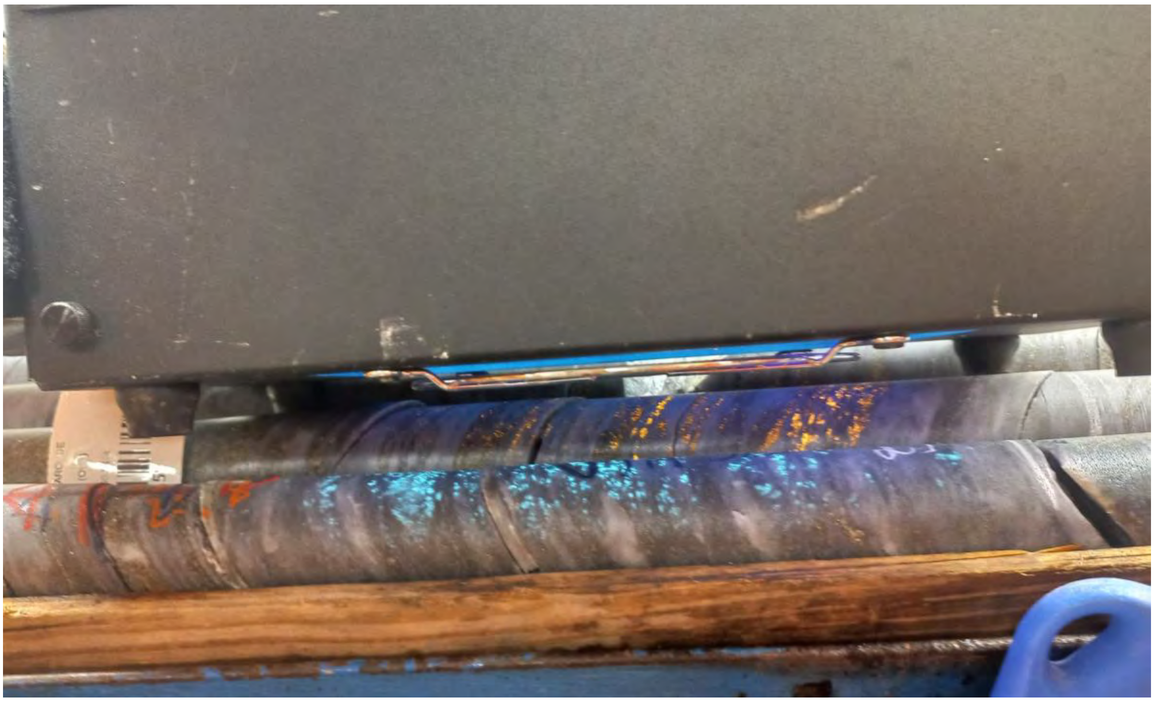

**Figure 13.** Drill cores under ultraviolet light highlight the presence of kyanite and sphalerite.

**Figure 14.** Giant amethyst geodes and a series of cross-section forming a 3D view from the Abitibi greenstone belt at the Musée minéralogique de l'Abitibit Témiscamingue in Malartic.

## ***Day 6:*** *Town of Cobalt*

On the last day of our field trip, we went to the town of Cobalt. Cobalt is most famous for its rich silver deposits, discovered in 1903, which led to one of the greatest silver rushes in North American history. The silver in Cobalt is often found associated with cobaltite (CoAsS) and other cobalt-bearing minerals, as well as native silver, arsenides, and sulfides. These minerals are hosted in carbonate veins that crosscut Archean host rocks, indicating a significant post-Archean mineralizing event. The veins are typically found in fractures, faults, and breccias, suggesting that mineralization was controlled by structural features and likely associated with hydrothermal fluids.

Upon arrival we headed to a few outcrops on the outskirts of the town where we could see old historical vertical mining works (Fig. 15) and a few cm-thick mineralized veins with native silver, arsenides, sulfides and cobalto calcite which correspond to a pink to purple variety of calcite common in the area.

Apart from its rich mining history, the town of Cobalt also contains outcroppings of Proterozoic glaciogenic diamictites deposited by the terminal glaciation recorded by the Gowganda Formation of the Huronian Supergroup. The Paleoproterozoic glacial deposits have been serendipitously exposed and polished by more recent Quaternary glaciations recording the effects of continental ice sheets separated in time by more than 2 billion years. The glacial diamictites, and overlying fluvio-deltaic deposits, record a period of intense climate change during the Paleoproterozoic (i.e., from frigid glacial to temperate interglacial conditions) which has been linked to the first rise of oxygen in Earth's atmosphere. This time in Earth's history has been labelled as the "Great Oxidation Event" and had implications for numerous geological (e.g., mineral diversity and stability) and biological (e.g., oxygen utilising metabolisms) processes.

**Figure 15.** Historical mining vertical works near the cobalt town and a small mineralized vein that stands out for the pinkish erythrite mineral.

## Acknowledgments

We would like to thank our academy and industry mentors, **Stephen J. Piercey and Lawrence Winter**, for their helpful advice and for providing useful industry contacts while planning the field trip. We thank Shirley Peloquin, Bailey McKinnon, Matt Krukowski and the rehabilitation officers of the Ontario Geological Survey; Kathleen McDonald, Aminat Popoola, Chris Hicks, and Clarence Pickett of Vale; Claude Pilote and Francis Gonthier of Falco Resources; Guy Gosselin and David Pitre of Agnico Eagle; and Peter Harvey and Justin Georg of Newmont Corporation for sharing their resources, time and expertise for this field trip.