Lithological and Structural Setting of the Cubric Ni-Cu-(PGE) Showing, Southern Abitibi Subprovince, Quebec

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INTRODUCTION

The Amos–Malartic transect is one of several metal-endowed geological-geophysical traverses in the Abitibi greenstone belt being studied as part of the Metal Earth project. The transect intersects the Malartic group in the southern Abitibi greenstone belt. The 2714 ±2 Ma (Pilote, et al., 1998) La Motte–Vassan formation represents the oldest rocks of the Malartic group, consisting of komatiite, basalt and felsic-intermediate volcanic rocks. The La Motte–Vassan formation hosts several Ni-Cu-(PGE) occurrences, including the historic Marbridge mine, which produced 702 224 tonnes of ore grading 2.28% Ni and 0.1% Cu (Sphinx Resources Ltd., 2015), and the Cubric showing, located 3 km east of the mine. The genesis of the mineralization at the Cubric showing is poorly understood due to its structural complexity. The goal of this project is to better constrain the geological controls on Ni-Cu-(PGE) mineralization in the La Motte–Vassan formation to assist in understanding metal endowment along the Amos–Malartic transect. The area surrounding the showing was mapped using a combination of bedrock mapping, core logging and data from an airborne magnetic survey.

REGIONAL GEOLOGY

The Cubric–Marbridge area is located in La Motte Township, about 3 km west of the village of La Motte, Quebec (Figure 1). The supracrustal rocks of the La Motte–Vassan formation consist of komatiite, basalt and sedimentary rocks as well as a lesser quantity of felsic volcaniclastic rocks, which are intruded by gabbroic and granitic dikes (Imreh, 1984). The felsic volcaniclastic rocks within the La Motte–Vassan formation yielded a Pb-U zircon age of 2714 ±2 Ma (Pilote et al., 1998). These supracrustal rocks are surrounded by three major intrusions: the ca. 2647 Ma La Motte pluton, the ca. 2681–ca. 2660 Ma Preissac pluton and the ca. 2680–ca. 2632 Ma La Corne pluton (Carignan et al. 1991; Ducharme et al. 1997). The ages of the La Motte and Preissac plutons were determined using Pb-U monzonite geochronology, whereas the age of the La Corne pluton was determined using Pb-U zircon geochronology (Carignan et al. 1991; Machado et al. 1991 Ducharme et al. 1997). The Cubric–Malartic area occurs along the southern limb of the La Motte anticline (Imreh, 1984) within the Southern Manneville deformation zone, a splay of the regional Porcupine–Destor–Manneville fault (Daigneault et al., 2002).

METHODS

In the summer of 2018, the geological setting of the Cubric showing was determined; fifteen stations in a 4 km^2 area around the showing were mapped. The outcrop-cale map of the Cubric showing from the previous field season was modified (Figure 2) as new information became available, and an additional map and sketch (Figures 3, 4) at the outcrop scale were completed in the Cubric area to help relate the outcrops to the regional map pattern. A high-resolution drone magnetic survey completed in April 2018 became an important tool in the development of the geological map. The first horizontal derivative was used to map the contacts of several units where outcrop was lacking, and a regional fold pattern was identified using this method. In February 2018, some 105 m of drill core from the Marbridge site provided by Sphinx Resources Ltd. was re-logged, sampled and compared to samples from the Cubric area. In August 2018, Globex Mining

Enterprises Inc. provided access to over 300 m of drill core, which were also re-logged and sampled this summer.

ROCK UNITS AT THE CUBRIC NICKEL SHOWING

There are eight different rock units at the Cubric showing: granite, intermediate intrusive rocks, semi-massive sulphides, iron formation, hornblende gabbro, ultramafic rocks, amphibole schist and biotite schist (Figure 2). The granite at the northwestern end of the outcrop is mineralogically similar to the Preissac pluton and is located in proximity to it. The intermediate intrusive rocks are fine to medium grained, appear grey to brown on fresh surfaces and are extremely hard; they are interpreted as a roof pendant between the La Corne pluton and the Preissac pluton. The iron formation consists of alternating massive magnetite-sulphide bands, with occasional interbedded chert (0.5–1 cm thick) with saccharoidal texture. At the Cubric showing, the bedding of the iron formation runs parallel to the early foliation. Although small in volume, the iron formation is extremely magnetic. By far the most abundant rock type at the Cubric showing is a hornblende gabbro, which consists of 30–50% plagioclase and 50–70% hornblende. Grain sizes within the hornblende gabbro vary across the unit from leucocratic pegmatitic-textured pods near the contacts with supracrustal rocks, to mesocratic coarse to medium grained in the centre, to fine-grained melanocratic near the mineralized body. One of these leucocratic pods yielded a $^{207}Pb/^{235}U$ zircon age of 2680.5 ±1.5 Ma. This age is consistent with the early felsic phase of the La Corne pluton (Carignan et al. 1991; Ducharme et al. 1997). The ultramafic rock is talc-carbonate altered, with small (<1 mm) magnetite bands. The amphibole schist is distinctly dark green and consists of medium-to coarse-grained acicular amphibole. This unit is typically 15–20 cm thick and non-uniform in mineralogy with thin, continuous sulphide bands 2 mm thick running parallel to foliation. This schist unit has distinct ends, indicating it may be rafts within the hornblende gabbro rather than a late intrusive body. The biotite schist found in contact with the amphibole schist is black, very soft and is composed almost exclusively of medium-grained biotite.

MINERALIZATION

At the Cubric showing, there are two very distinct sulphide textures: within the hornblende gabbro, sulphides are semi-massive and brecciated, whereas within the silicate-facies iron formation, sulphides and amphibole schist occur in folded bands parallel to the primary foliation. Mineralization consists of pyrite-pyrrhotite-magnetite-chalcopyrite±pentlandite±violarite, with grades up to 2.5% Ni and 0.2% Cu at the surface. A high-grade mineralized body was not observed in drill core and is interpreted as not extending at depth.

STRUCTURAL GEOLOGY AND DEFORMATION HISTORY

In addition to grid mapping and core logging, a magnetic survey was used to interpret the geology within a 4 km^2 area around the Cubric showing (Figure 5). Potential evidence for a S_1 cleavage can be observed in a 20 cm xenolith within the hornblende gabbro (Figure 6). Xenoliths of this mineralogical and textural type are observed up to 6 km away within the hornblende gabbro phase of the La Corne pluton but only at the Cubric showing is a xenolith with internal foliation present. A thin section will be made to determine if this is an igneous or tectonic fabric. For consistency within this report, it will be assumed to be a tectonic foliation and other deformation events follow in sequence. The northwest-striking, steeply dipping foliation is the principal S_2 cleavage observed throughout the La Motte–Vassan formation. The mineral lineation on this cleavage plunges moderately to the east. The S_2 cleavage is axial planar to northwest-striking, upright, isoclinal to tight, regional folds in this area. The D_2 deformation relating to these structures is a northeast-southwest shortening event. These folds are overprinted by a late northwest-southeast D_3 shortening event, which produced northeast-striking open folds. This interpretation is based on aeromagnetic data and is validated by outcrop-scale observations. An outcrop shows an isoclinally folded east-striking quartz vein overprinted by late tight to open northeast-striking folds (Figure 5). The north-northeast–striking sub-vertical crenulation cleavage is axial planar to the late northeast-striking folds.

DISCUSSION AND CONCLUSION

The mineralization at the Cubric showing is located within the iron formation and the hornblende gabbro. The $^{207}Pb/^{235}U$ zircon age of 2680.5 ±1.5 Ma for the gabbro establishes a maximum age for mobilization and constrains the timing of the D_2 and D_3 deformation events. However, there is a discrepancy in the mineralogy and geochemistry of the Cubric showing as the trace amounts of pentlandite present cannot account for the 2.5% Ni. Two hypotheses have been considered to explain the Ni enrichment: 1) mobilization from a komatiite-hosted deposit during deformation and modification by metamorphic hydrothermal fluids or 2) precipitation from a hydrothermal fluid. Whole-rock geochemistry and assay data show that mineralization at the Cubric showing has a high Ni/Cu ratio consistent with a komatiitic origin and occurs close to an ultramafic body. However, the most abundant sulphide mineral is pyrite, which is commonly associated with hydrothermal activity. Moreover, the pyrite crystals are associated with hydrothermal-alteration minerals such as biotite and chlorite. Unfortunately, evidence for both hypotheses is circumstantial and must be tested using more robust methods to determine genesis. One such method involves using trace-metal geochemistry including iridium and chromium, which are virtually insoluble in hydrothermal fluids but are commonly found in magmatic systems (Lesher and Keays, 2002). Studying these elements will prove useful in attempting to resolve these hypotheses. Scanning electron microscopy will be conducted on Ni-bearing minerals to reveal mineral phase and potential overprinting textures on the microscopic scale. If the system is determined to be magmatic, the relative mobilities of the entire suite of base and precious metals during deformation and metamorphism will be established.

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FIGURES

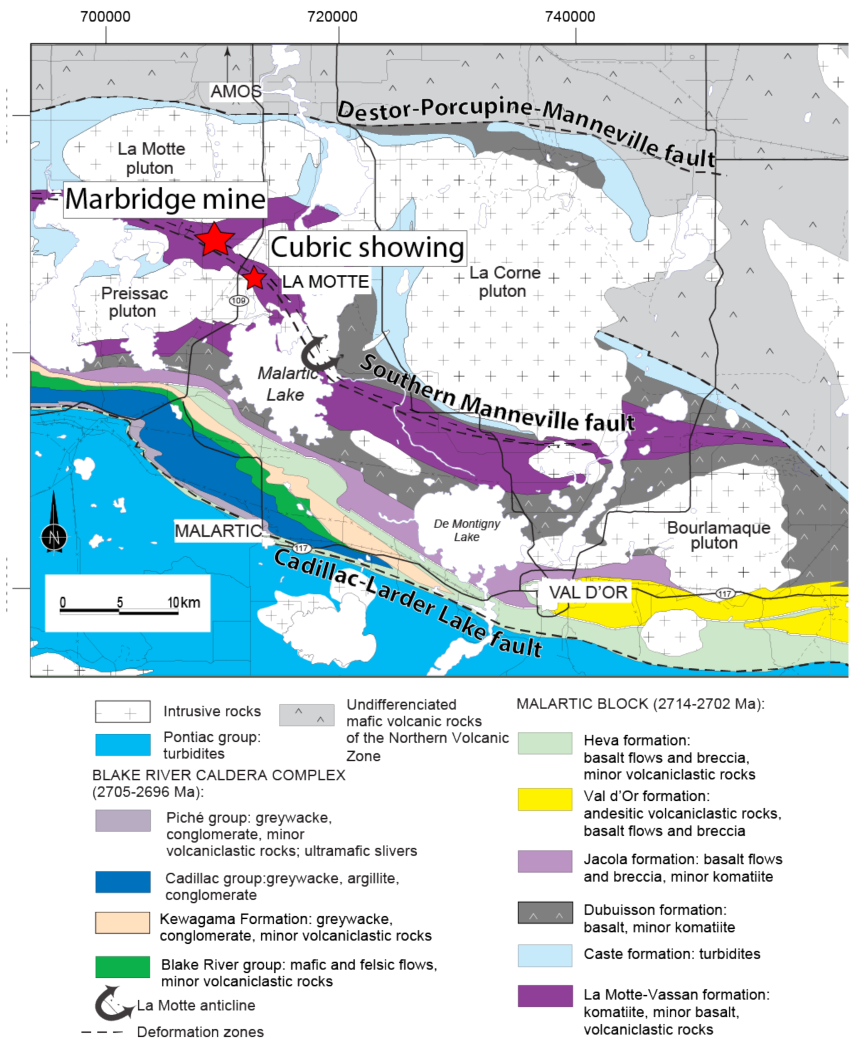

Figure 1. Simplified geology of the Malartic transect area, southern Abitibi Subprovince, with location of the Cubric outcrop. Figure *modified from* Mueller et al. (2008).

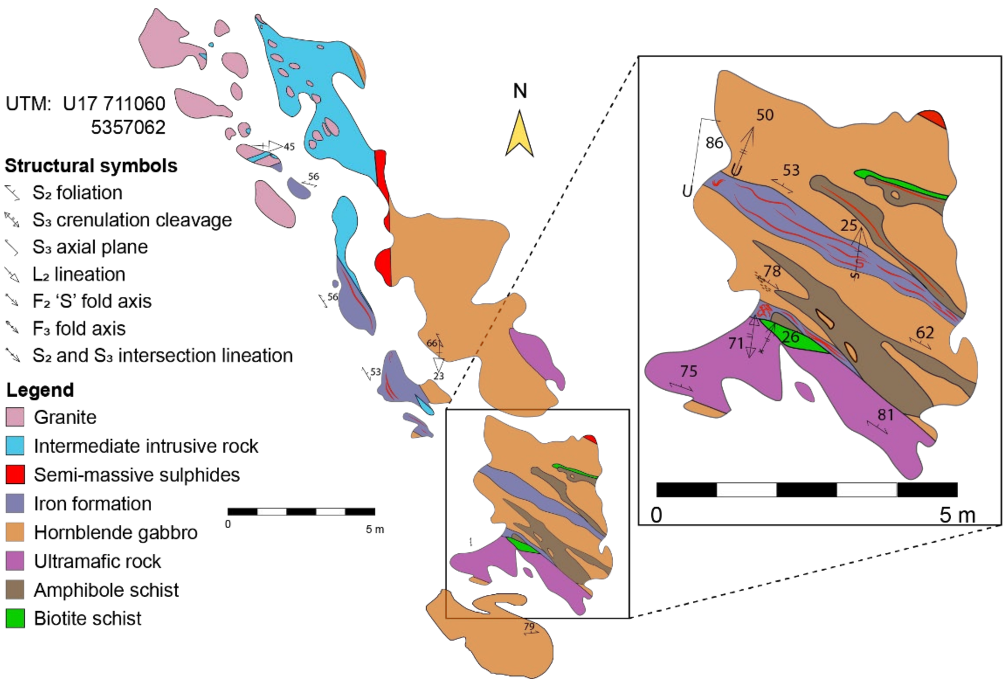

Figure 2. Outcrop map of the Cubric Ni showing, southern Abitibi Subprovince (inset of area with more detailed mapping). Figure *modified from* Shirriff, et al. (2017).

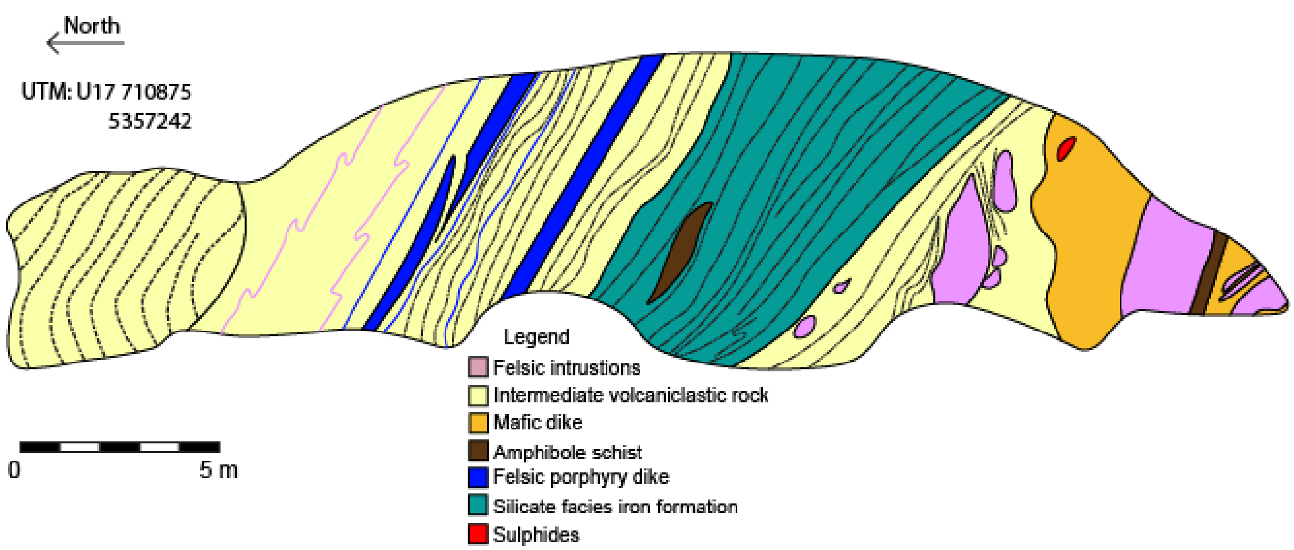

Figure 3. Road-cut outcrop map along strike of the Cubric showing; vertical section faces west.

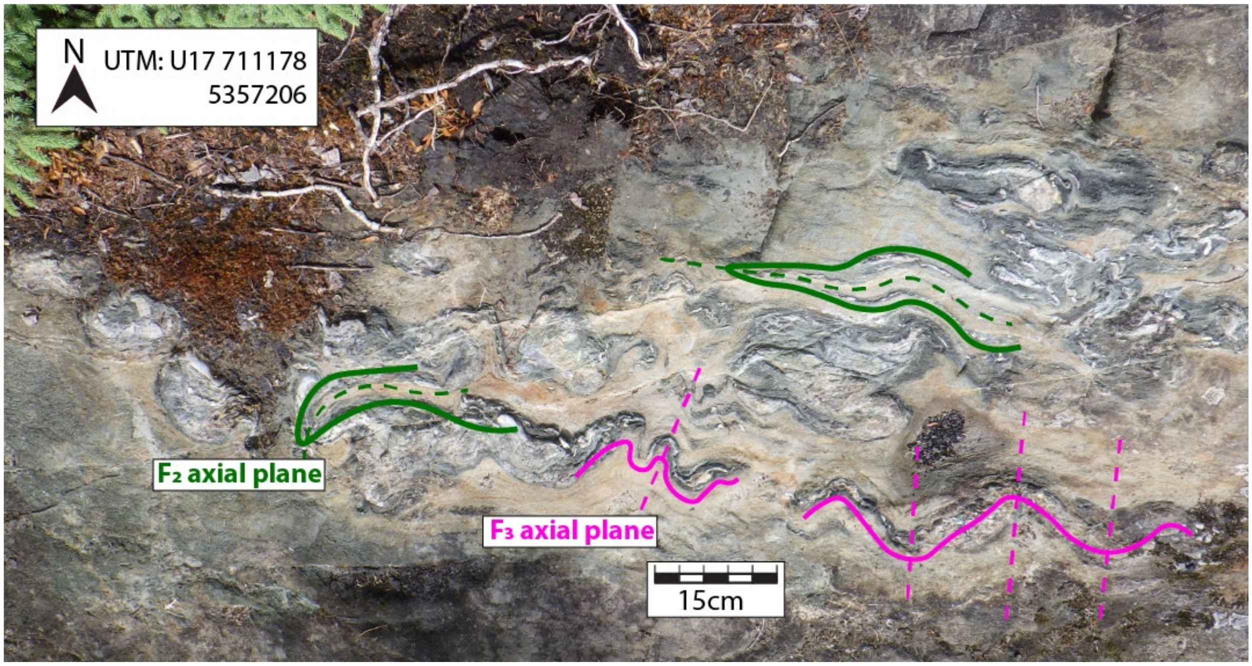

Figure 4. Field photograph showing a F_2 and F_3 fold interference pattern. Isoclinally F_2-folded quartz veins are overprinted by F_3 folds. The F_2 fold trace is indicated in green, with the axial plane as a green dashed line; the F, fold trace is indicated in pink with a pink dashed line as the axial plane.

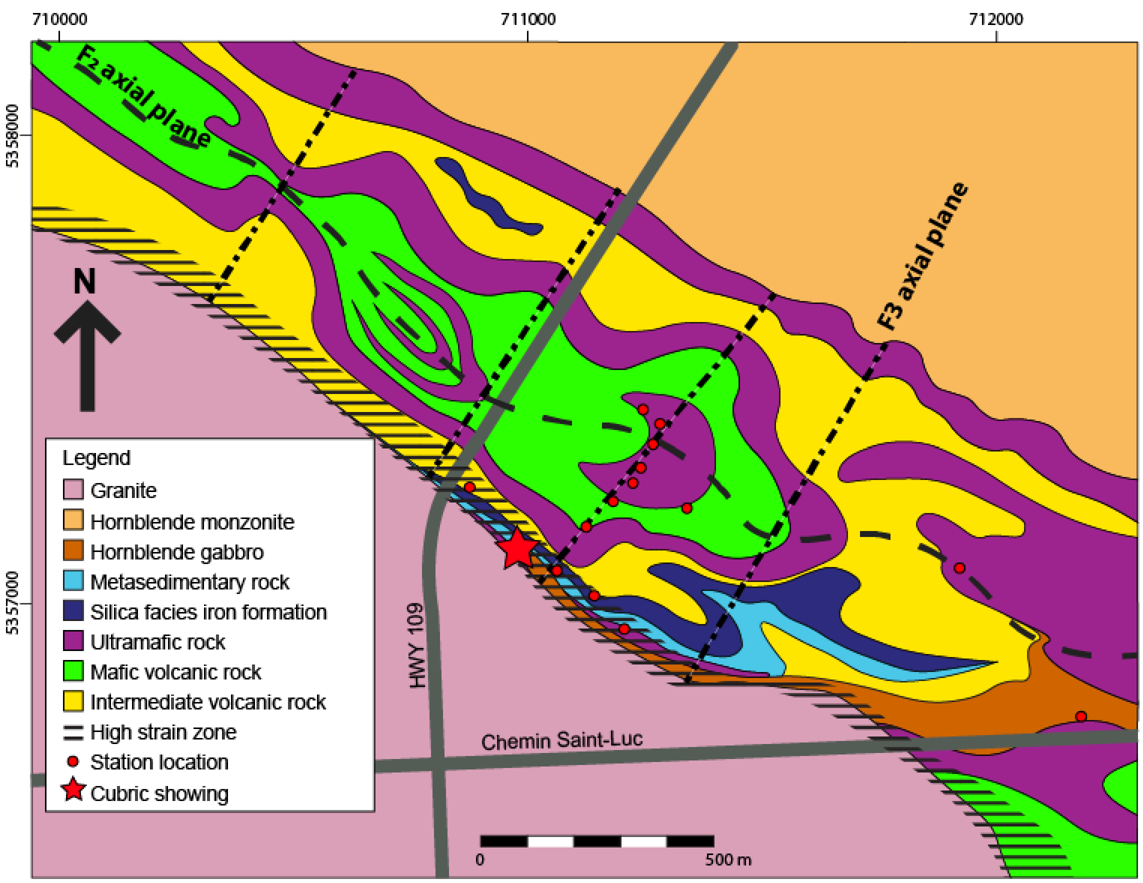

Figure 5. Aeromagnetic map interpretation of the Cubric surrounding area, showing location of. F_2 and F_3 fold traces.

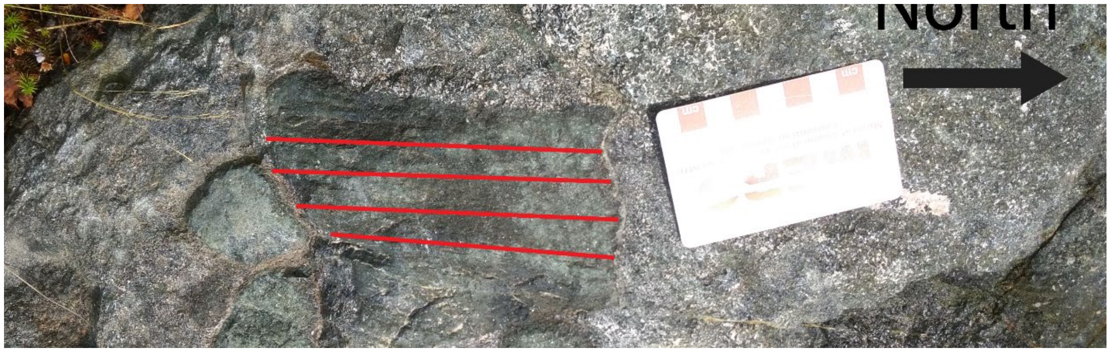

Figure 6. Field photograph showing xenolith with an S_1 cleavage possibly indicating an early deformation event.