Lithological and structural setting of the Cubric nickel showing, Southern Manneville fault, southern Abitibi Subprovince, Quebec

Danielle Shirriff, Xiaohui Zhou and Bruno Lafrance

Mineral Exploration Research Centre, Harquail School of Earth Sciences, Laurentian University, Sudbury, Ontario, P3E 2C6

INTRODUCTION

The Abitibi greenstone belt is known for its numerous gold and copper-zinc mineral deposits. Less-known nickel mineralization is hosted in supracrustal rocks of the La Motte–Vassan formation of the Malartic group. This includes the past-producing Marbridge deposit, which was mined in the 1960s, and four other nickel showings, including the Cubric, Ataman, Cominco and La Motte–Leblanc nickel showings (Jolin, 2015). The genesis of nickel mineralization at the Cubric nickel showing is poorly understood due to its geological complexity, especially since it is hosted in a high-strain zone along the Southern Manneville fault. In the summer of 2017, a M.Sc. thesis mapping project on the Cubric nickel showing was initiated as part of the Malartic-transect mapping program of a Metal Earth initiative. The goal of this thesis project is to study the stratigraphic and structural setting of nickel mineralization at the Cubric nickel showing to see how it compares with that in the Marbridge mine area.

REGIONAL GEOLOGY

The Cubric–Marbridge area is located in La Motte Township, about 3 km northwest of the village of La Motte, Quebec (Figure 1). The supracrustal rocks of the La Motte–Vassan formation consist predominantly of komatiite, basalt and minor felsic volcaniclastic rocks, which are intruded by gabbroic and granitic dykes. The komatiite shows steam vents and spinifex texture, and the basalt exhibits pillow structures, which suggest extrusion of the lava under water (Champagne, 2004; Lafrance, 2015). The felsic volcaniclastic rocks yielded a $^{207}Pb/^{206}Pb$ zircon age of 2714 ±2 Ma (Pilote et al., 1998). The supracrustal rocks are intruded by three major plutons: the ca. 2642 Ma La Motte pluton, the ca. 2681–2660 Ma Preissac pluton and the ca. 2680–2642 Ma La Corne pluton (Carignan et al. 1991; Ducharme et al. 1997). The La Motte–Vassan formation underwent several deformation events.

METHODS

Regional mapping was done on the La Motte–Vassan formation at 1:5000 scale. Three outcrops were mapped in detail at the 1:50 scale: the Cubric nickel showing, a stripped outcrop along strike of the Marbridge mine horizon and a roadcut outcrop along strike of the Cubric nickel showing. In total, 52 samples were collected for petrographic and whole-rock major- and trace-element geochemical analysis. Two samples were collected for U-Pb zircon geochronology to constrain the absolute timing of mineralization and remobilization of the ore.

ROCK UNITS AT THE CUBRIC NICKEL SHOWING

From south to north, the Cubric nickel showing consists of gabbro, komatiite, banded iron formation with cherty beds, late mafic dykes, mafic to intermediate metavolcanic rocks and granite. The gabbro

typically displays fine-grained chilled margins and pegmatite centres. At the northern end of the outcrop, the gabbro contains xenoliths of metavolcanic clasts. It consists of 30–50% plagioclase, and 50–70% hornblende and pyroxene. The komatiite is talc altered and magnetic (~50×10^{-3} siemens per metre [S/m]). The banded iron formation consists of alternating magnetite and chert beds 0.5–1 cm thick with saccharoid texture. In contrast to the komatiite, it is extremely magnetic (2000×10^{-3} S/m). The late mafic dykes have a distinct dark green weathering colour and consist of black, medium-grained acicular amphibole. The mafic to intermediate metavolcanic rocks are fine grained and grey to brown on fresh surfaces. A late granite crosscuts the banded iron formation and metavolcanic rocks (Figure 2a).

MINERALIZATION

Mineralization is present in the banded iron formation and along its contact with the gabbro (Figure 2b). It consists of pyrite, chalcopyrite and pentlandite. In the banded iron formation, the sulphides occur as layers parallel to isoclinally folded bedding planes. Sulphides occur as disseminations in the late mafic dykes, and as anastomosing stringer sulphide veins at the contact between the banded iron formation and gabbro. A massive sulphide pod, roughly 10–20 cm in diameter, is present within the gabbro, which otherwise is unmineralized except along its contact with the banded iron formation.

In 2007, Exploration Bull's Eye and Services Géologiques T-Rex Inc. completed a drilling program consisting of ten holes on the Cubric nickel showing and the surrounding area. Assays from the core and surface samples returned values of up to 5.33 wt. % Ni, 1.47 wt. % Cu, 1.5 ppm platinum-group elements, 33 ppb Au and 4 ppb Ag (Stoch 2000; Théberge, 2008).

STRUCTURAL GEOLOGY AND DEFORMATION HISTORY

Four generations of structures are present at the Cubric nickel showing. Early D_1 structures are represented by foliated fragments of metavolcanic rocks within the gabbro (Figure 3a). Later D_2 structures are represented by isoclinal upright folds plunging moderately (~35º) to the north. The folds have an axial planar cleavage striking northwest and dipping moderately (~50–70º) to the northeast (Figure 3b). The cleavage affects all rock types and is the most pronounced and penetrative structure observed on outcrops. Late upright, northeast-plunging S-folds, with a northwest-striking steeply-dipping crenulation cleavage, overprint the penetrative cleavage, which is displaced in a dextral sense along the crenulation cleavage (Figure 3c). Some S-C fabrics, indicative of dextral shearing, are observed on outcrops but their relationship to the S-folds and the crenulation cleavage is not known (Figure 3d).

DISCUSSION AND CONCLUSION

Early mineralization at the Cubric nickel showing is expressed as a large pod or clast within the gabbro intrusion, which suggests that it predates the emplacement of the gabbro. The mineralization was then remobilized during deformation, as it occurs as deformed stringers along the sheared contact between the banded iron formation and gabbro. Thus, the mineralization was likely initially associated with komatiite at its contact with the banded iron formation, then dissected and displaced during the emplacement of the gabbro, and later remobilized during deformation of the gabbro and its host metavolcanic rocks. Future exploration and drilling programs should therefore focus on the northern contact of the gabbro, and along the contact between the gabbro and sheared banded iron formation.

FUTURE WORK

Petrographic and lithogeochemical analysis, and U-Pb dating will be done on selected samples to characterize the tectonic setting of the rocks hosting nickel mineralization, and to determine the timing

and style of sulphide remobilization. Fieldwork will be done next summer on the other three nickel showings: Ataman, Cominco and La Motte–Leblanc. Comparisons between all four nickel showings will be made to better understand the genesis of nickel mineralization and remobilization in the La Motte–Vassan formation within the Southern Manneville fault.

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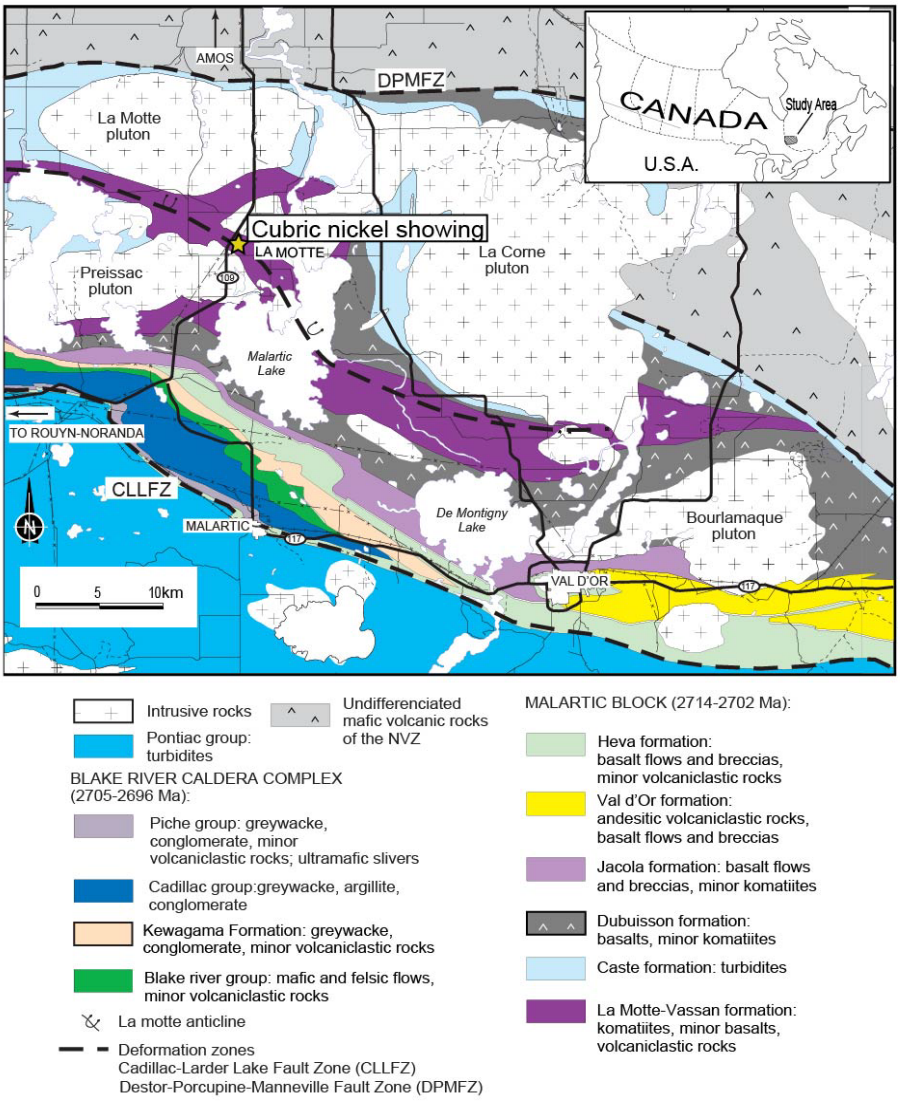

Figure 1. Simplified geology of the Malartic-transect area, southern Abitibi Subprovince; the location of the Cubric outcrop is indicated (modified from Mueller et al., 2008).

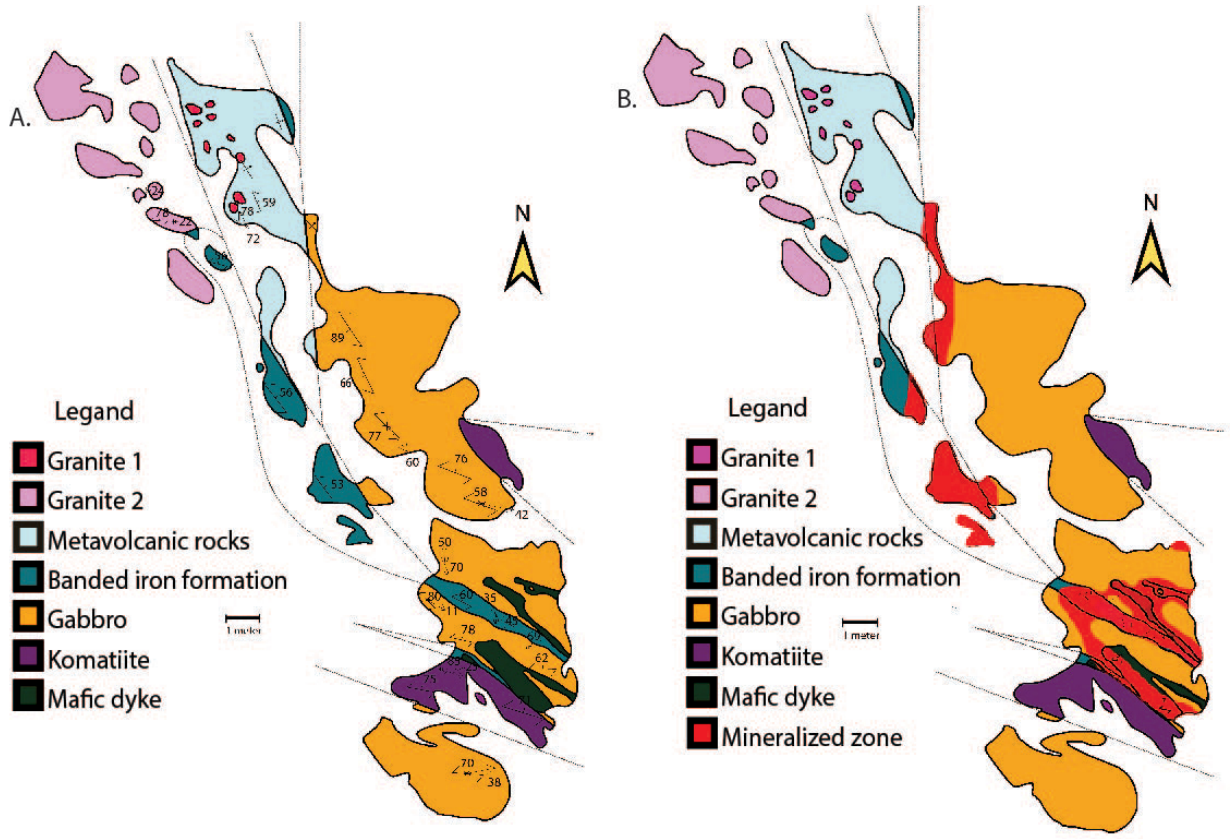

Figure 2. Outcrop map of the Cubric nickel showing, southern Abitibi Subprovince: **a)** rock types and their structural measurements from the outcrop; **b)** distribution of the ore body through the outcrop.

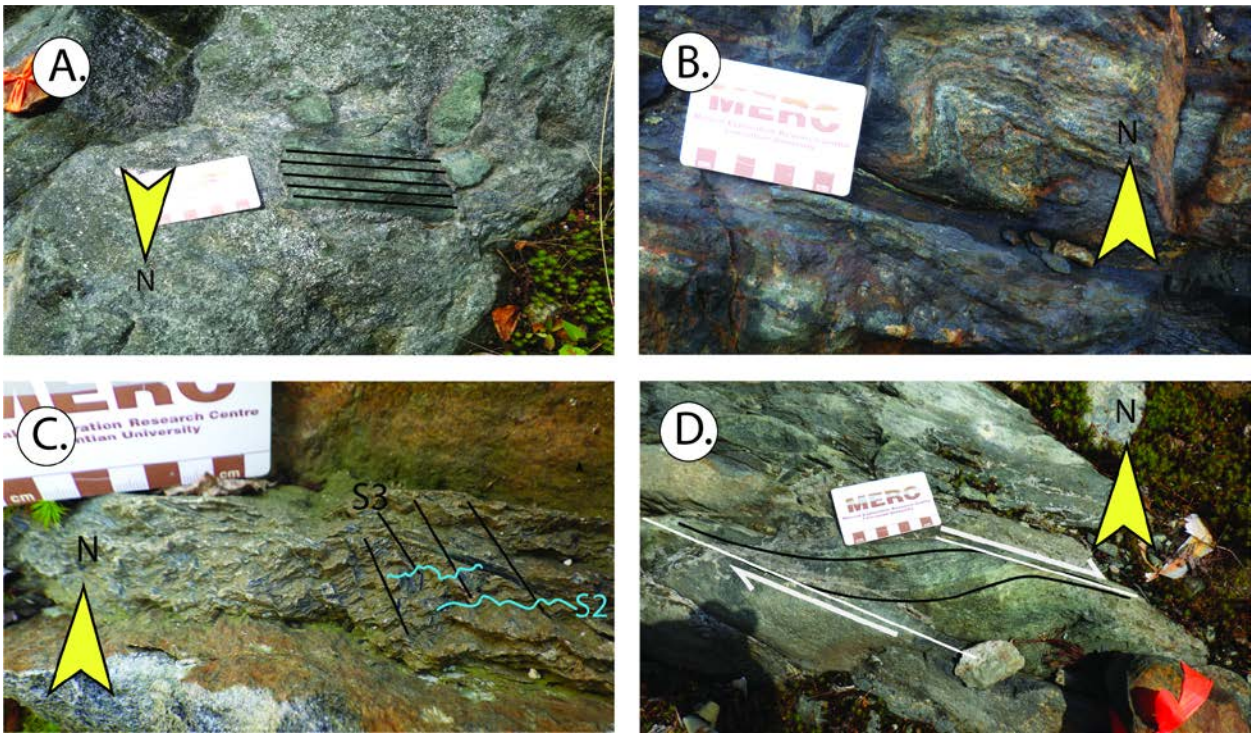

Figure 3. Field photographs of deformation structures at the Cubric nickel showing, southern Abitibi Subprovince: **a)** gabbro with foliated metavolcanic xenoliths and foliation indicated by solid black lines; **b)** S-shaped F_2 folds in banded iron formation; **c)** S_3 crenulation cleavage at the southern end of an outcrop, with S_2 and S_3 foliations traced in blue and black, respectively (note slight dextral offset along the S_3 foliation); **d)** S-C fabrics in ultramafic rocks, with shear line traced and direction of movement indicated. Scale card is 9 cm in length.