Characterization of alteration systems associated with synvolcanic intrusions and VMS mineralization in the Duprat-Montbray formation, lower Blake River Group

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Introduction

The 2701.9 ±0.9 Ma upper Duprat-Montbray formation (DMF; Fig.1) consists of a less metal endowed volcanic stratigraphy of the Blake River Group, similar in age to the successions that host the Au-rich Horne (6.06 g/t) and Quemont (5.49 g/t) VMS deposits. It hosts two small VMS deposits (Fabie and Magusi; Table 1) that are located proximal to the 2700.6 ±1.0 Ma synvolcanic Fabie pluton (Fig. 2).

Project Goals

- Further define the volcanic stratigraphy of the DMF and determine the relationship between the Fabie pluton and the two VMS deposits.
- Produce an alteration map utilizing $\delta^{18}O$-isotopes and lithogeochemistry in order to understand the hydrothermal system, constrain the magnitude of fluid-rock interactions and construct a geological model for the formation of the Fabie and Magusi deposits.
- Compare results to more prolific VMS mineralized stratigraphy of similar age in the Noranda camp.

Geological Setting

The DMF is located north-west of the Noranda central mining camp and juxtaposed against the Renault-Dufresnoy formation along the Fabie Bay shear zone (Fig. 1 and 2). The stratigraphy is characterised by alternating basaltic-andesite pillowed and massive flows and rhyolitic massive-coherent and volcaniclastic units. It is intruded by the Fabie pluton, a Qtz-Pl porphyritic tonalite and late diorites.

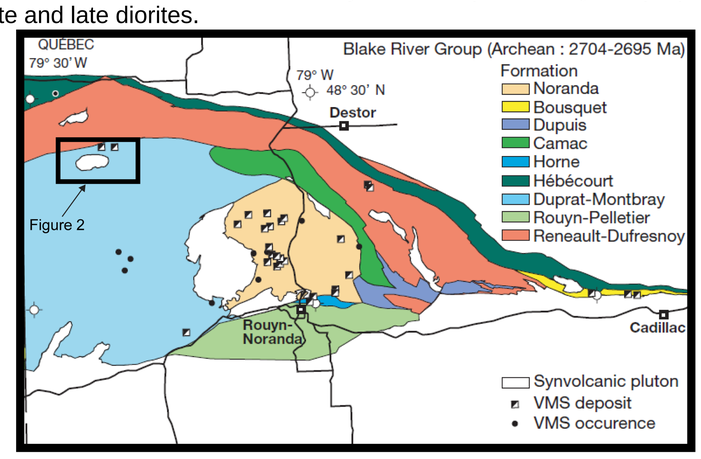

Figure 1. Stratigraphic subdivision of the Blake River Group in Quebec. Black square indicates the study area, located below the contact of the Reneault-Dufresnoy and DMF image modified from *McNicoll et al., (2014)*.

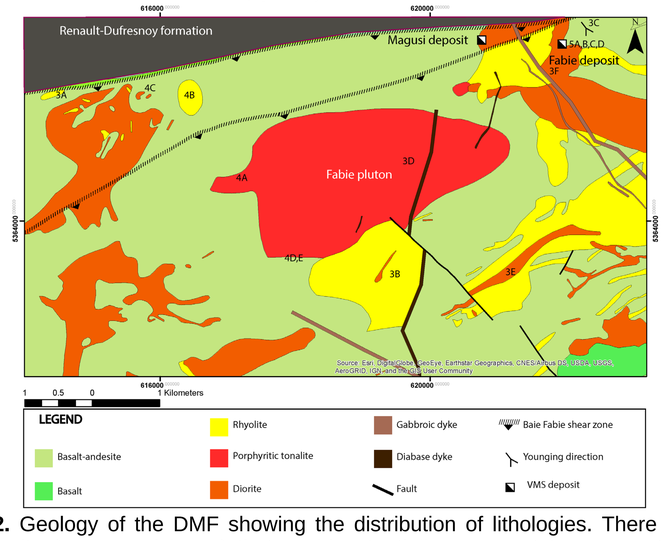

Figure 2. Geology of the DMF showing the distribution of lithologies. There are two rhyolite units (upper and lower) that could potentially represent two separate flows. Triangles located near the Baie Fabie shear zone indicate which blocks thrusted above the other. Letters and numbers correspond to location of figures. Coordinates are presented as NAD 83, zone 17. Map is modified from SIGEOM.

Lithologies

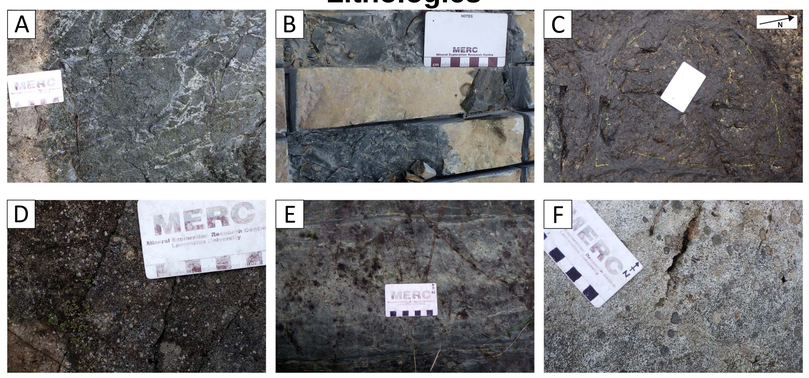

Figure 3. Outcrop photos of volcanic and intrusive units in the DMF. A) Volcaniclastic rhyolite composed of a monomictic tuff-breccia, this is interpreted to be flow-top breccia from the upper rhyolite unit. B) Coherent rhyolite located in the lower rhyolite unit. C) Pillow basaltic-andesite younging to the North-West. D) The Fabie pluton which consists of a Qtz-Pl porpyritic tonalite. E) Qtz-Pl porphyry dykes that cross-cuts a diorite. F) Massive fine- to medium-grained diorite.

Volcanic and Intrusive Textures

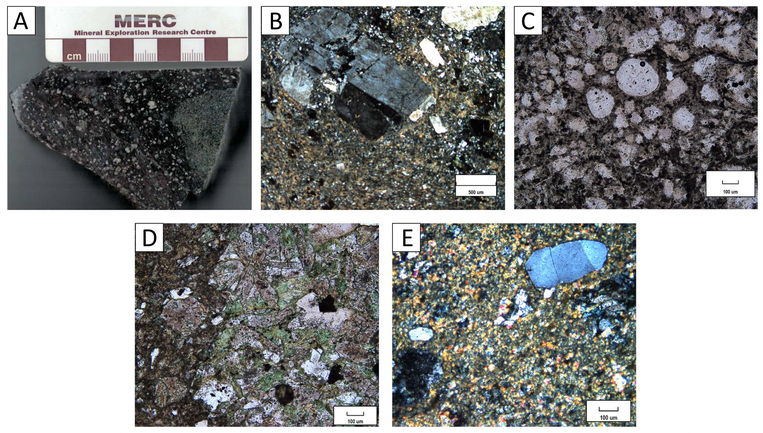

Figure 4. Hand sample photos and thin section photomicrographs of volcanic and intrusive textures. A) Fabie Qtz-Pl porphyritic tonalite containing a coarse-grained xenolith. B) Carlsbad twinning in Pl porphyritic rhyolite indicating quick cooling of the melt. C) Rounded Qtz amigdules hosted in very-fine grain andesites. D) Chlorite altered andesites in sharp contact with the Fabie tonalite, note the recrystallization of Pl. E) Pervasive sericite alteration in the Fabie tonalite, note the well preserved Qtz phenocrysts.

VMS Deposits and Mineralization

Table 1. VMS deposits located within the research area in the DMF. Values were obtained by *Mercier-Langevin et al., (2011)*.

VMS deposit name	Tonnage (Mt)	Cu (%)	Zn (%)	Au (g/t)	Ag (g/t)
Magusi	1.68	3.30	5.13	1.84	65.9
Fabie	0.46	2.53		0.02	1.23

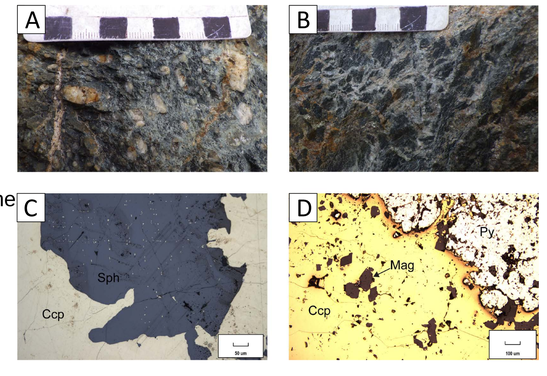

Figure 5. Hand sample photos and thin section photomicrographs from the Fabie deposit. A) Qtz amigdules located in andesite hanging wall. B) Qtz-carbonate veins with sulphide mineralisation in the footwall. C) Chalcopyrite disease indicated by Ccp inclusions in the Sph. D) Mag inclusions hosted in Ccp and Py. Indicates a paragenesis of Mag→Ccp-Py.

Regional $\delta^{18}O$-isotopes

The Blake River group has been extensively sampled for whole-rock $\delta^{18}O$-isotope research. These studies have successfully linked synvolcanic intrusions to nearby VMS deposits by mapping the $\delta^{18}O$ alteration footprint and constraining the hydrothermal system *(Cathles, 1993)*. This research has also successfully characterised the $\delta^{18}O$ values in Noranda as the following:

- <6‰ indicates high temperature (>300ºC) alteration.
- 6-9‰ indicates isotopically normal or fresh rock values.
- >9‰ indicates low temperature (<200ºC) alteration.

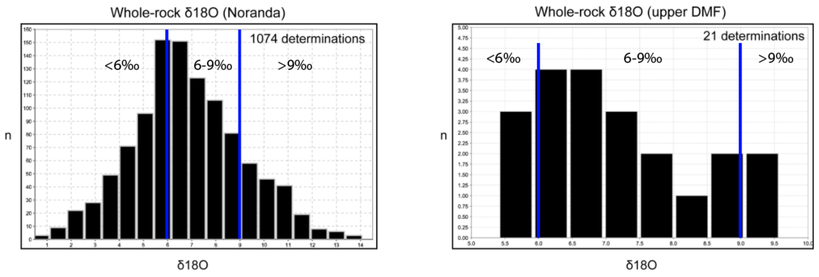

Figure 6. Histogram of compiled $\delta^{18}O$ samples in the Noranda camp and research area. Values are subcategorized to constrain the temperature of the hydrothermal fluids as discussed by Cathles (1993). Data provided by the Geological Survey of Canada.

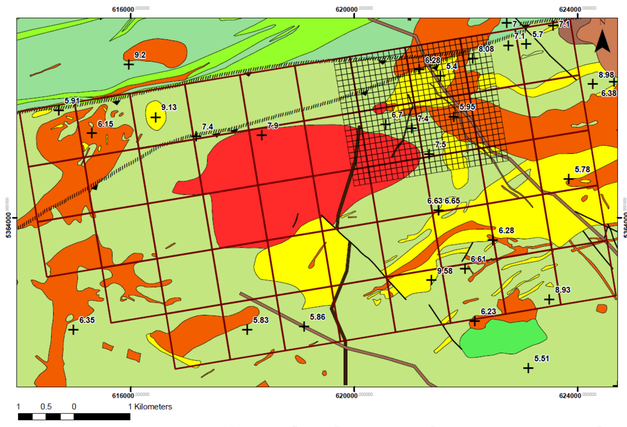

Figure 7. Geological map with compiled $\delta^{18}O$ data from the Geological survey of Canada. Includes a proximal and regional sample grid which will be utilized for the upcoming summer field mapping project. See legend in figure 2 for details.

Conclusion and Future work

The DMF volcanic stratigraphy was subject to various types of VMS alteration (e.g. chloritization, silicification and seritization; Fig. 4C,D,E), similar to other parts of the Noranda camp. The coarse-grain xenolith found in the Fabie pluton (Fig. 4A) could indicate a precursor intrusive phase, which could imply that the Fabie pluton is composite in nature. Historically collected samples for $\delta^{18}O$ in the area (Fig. 6) show potential to successfully map the hydrothermal alteration in the DMF. Future work will involve:

- Continue to map volcanic stratigraphy and VMS deposits in the DMF and intrusive phases hosted in the Fabie pluton.
- Collect additional $\delta^{18}O$ sample for whole-rock analysis in order to further define the hydrothermal alteration and document the relationship between the Fabie pluton and the Fabie and Magusi VMS deposits.
- Construct a geological model for mineralisation in the DMF and compare the overall data to other metal endowed formations in the Blake River Group.

Mineral Abbreviations

Ccp = chalcopyrite, Chl = chlorite, Mag = magnetite, Pl = plagioclase feldspar, Py = pyrite, Qtz = quartz, Sph = sphalerite

References

Cathles, L., 1993. Oxygen Isotope Alteration in the Noranda Mining District, Abitibi Greenstone Belt, Quebec: Economic Geology, 88: 1483-1511.

McNicoll, V., Goutier, J., Dube, B., Mercier-Langevin, P., Ross, P-S., Dion, C., Monecke, T., Legault, M., Percival, J. and Gibson, H., 2014. U-Pb Geochronology of the Blake River Group, Abitibi Greenstone Belt, Quebec, and implication for base metal exploration. Economic Geology, 109: 27-59.

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