Geochemical and physical variations in the late Triassic Nicola arc and metallogenetic implications: preliminary results

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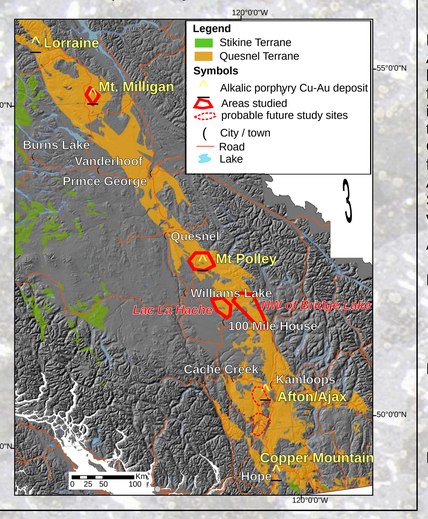
Location map of study sites



Introduction

Exploration for upper Triassic to Lower Jurassic Alkalic porphyry Cu-Au deposits in BC is challenging because of their narrow and cryptic alteration footprint and extensive cover. This project seeks to identify geochemical and physical properties unique to volcanic rocks within arc segments that may host Cu-Au mineralization and distinguish prospective from unprospective areas within the Triassic Nicola Arc (Quesnel Terrane, central BC).
Sampling for geochemistry was focused on coherent volcanic rocks or large volcanic clasts in breccias.

Areas studies so far are:

Mount Polley: Represents a porphyry Cu-Au deposit which is closely related in time to the hosting Upper Triassic arc rocks (Logan and Bath, 2006).

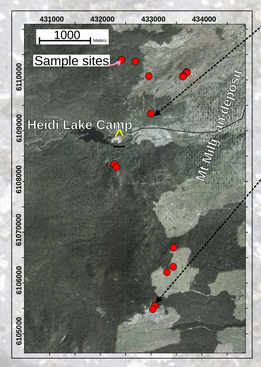
Mount Milligan: Representative for a Lower Jurassic Cu-Au porphyry deposit emplaced ~ 20 Ma after emplacement of Upper Triassic host rocks (Jago, 2008).

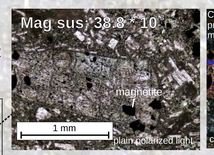
Lac La Hache prospect: Cu-Au mineralization of unknown age but sharing characteristics with Mount Polley

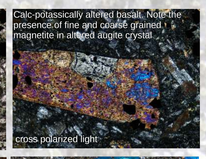
Northeast of Bridge Lake area: This area contains no known alkalic porphyry Cu-Au mineralization.

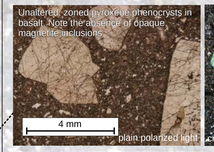
Mount Milligan

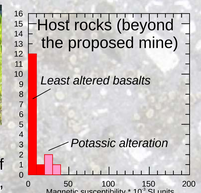
482.4 t grading 0.2% Cu; 0.39 g/t Au (Terrane Metals Corp., 2009)









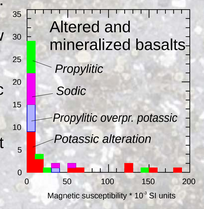


Mount Milligan represents the silica undersaturated class of alkalic porphyry deposits. It is at 182-183 Ma (Mortensen et al., 1995) at least 20 Ma younger than the volcanic host rocks.

The least altered coherent basaltic host rocks have low magnetic susceptibilities below $1 * 10^{-3}$ SI.

Potassic and calc-potassic alteration introduced and propylitic alteration partially destroyed magnetite.

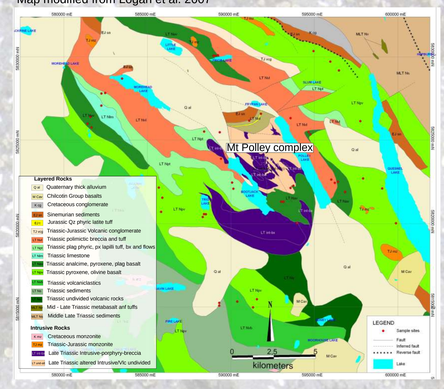
The host rocks were emplaced in a reduced arc environment and are not directly related to mineralization.

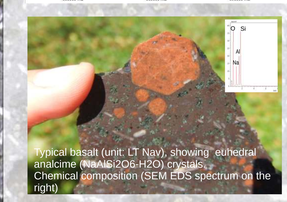


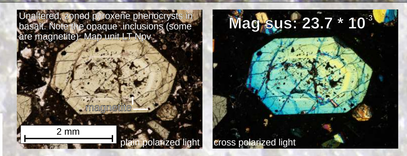
Mount Polley

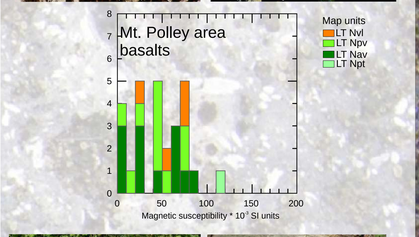
556 Mt grading 0.36% Cu; 0.3 g/t Au (Imperial Metals, 2009)

Map modified from Logan et al. 2007



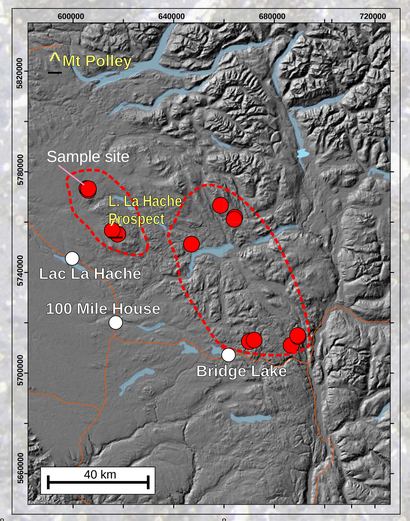


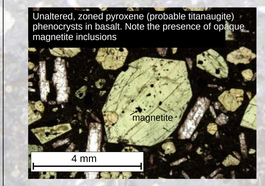


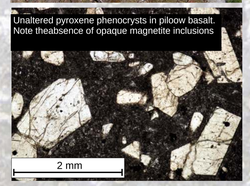


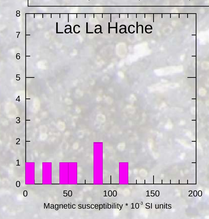
The volcanic host rocks (Nicola Group) around The Mount Polley Cu-Au porphyry deposit are lavas and associated volcaniclastic rocks of oceanic island arc origin, varying from basaltic to andesitic composition. The unit LT Nav is silica undersaturated evidenced by the presence of primary analcime crystals. The magnetic susceptibility shows a wide range from 0.2*10-3 SI to 111*10-3 SI, the high values are due to the presence of fine and coarse primary magnetite in fresh rocks, while the low values are related to the widespread hematitization or chlorite - epidote alteration. The latter could be sea floor or propylitic alteration, both are difficult to distinguish from each other

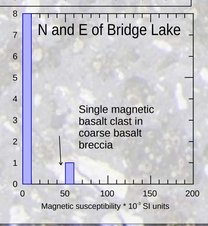
Lac La Hache and Bridge Lake Area





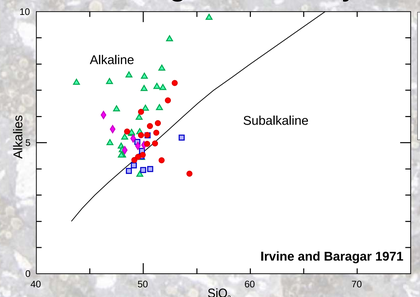


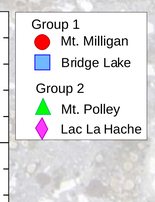


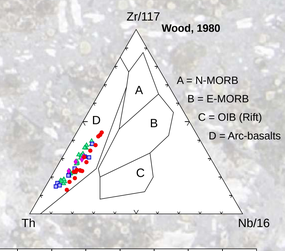


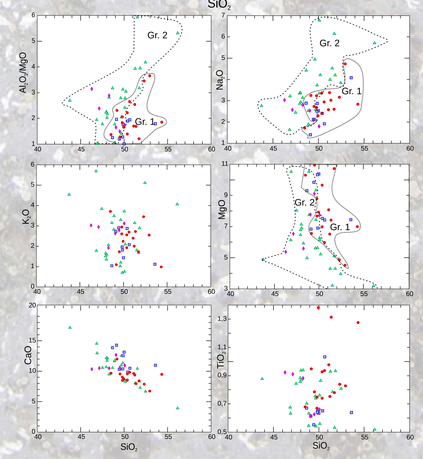
The host rocks around and north of of the **Lac La Hache** prospect (GWR Resources Inc.). share characteristics with those at Mount Polley. Magnetic susceptibilities of the freshest rocks are between 40 and 85 * 10^{-3} SI, but considerably lower where rocks have been altered to chlorite and epidote rich assemblages (alteration has also occurred on the seafloor). Locally the outcrops are hematitic.
In contrast, coherent basalts to the east, north and east of **Bridge Lake**, have low magnetic susceptibilities, typically < 10 * 10^{-3} SI. No significant Cu-Au mineralization is known from this area.

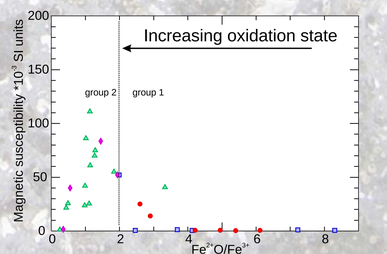
Whole rock geochemistry











The Nicola Group basalts straddle the alkalic –calc alkalic boundary and fall within the calc-alkalic basalt field in the Zr-Th-Nb diagram. The rocks can be assigned to two groups based on relatively subtle chemical differences and their oxidation state: group 1 includes basalts from the Bridge Lake and Mount Milligan areas and is characterized by low oxidation state (high FeO/Fe^{3+} ratios, low magnetic susceptibility), relatively high Mg but moderate Na content. Group 2 comprises the Mount Polley and Lac La Hache area and the basalts are relatively oxidized (low FeO/Fe^{3+} ratios, high magnetic susceptibility) and have low Mg and high Na content. Rocks from group 2 plot mostly within the alkaline field due to their high Na content.

Conclusions

The Nicola Group basalts hosting roughly coeval porphyry Cu-Au mineralization (Mt Polley) are more oxidized and slightly more alkalic than other parts of the Nicola Arc. The association of highly oxidized host rocks with alkalic porphyry Cu-Au deposits makes sense because the latter are also characterized by their high oxidation state (e.g. Chamberlain et al. 2007).

Mount Milligan has been emplaced more than 20 Ma after its host rocks which are relatively reduced, similar to areas where no mineralization is known from.

Basalts around Mount Polley and Lac La Hache are slightly more alkalic than those in the other areas studied indicating a link between alkaline chemistry and porphyry mineralization.

It is still unclear whether the variation in oxidation state of the arc reflects different environments along the strike of the arc or a temporal change and progressively more oxidizing conditions. However, regional mapping (Schiarizza et al. 2008) indicates that oxidized portions correspond to stratigraphically higher portions of the Nicola Group.

The magnetic properties of the host rocks have to be taken into account when interpreting aeromagnetic data, as magnetite rich porphyry mineralization may not be obvious within generally magnetic host rocks.

Acknowledgements

This project is funded by Geoscience BC and is part of a concerted effort to add value to the QUEST geochemical and geophysical survey data. BCGS geologists Paul Schiarizza and Jim Logan provided valuable information on the Quesnel Terrane and assisted with fieldwork and logistics, discussions with Kirstie Simpson helped clarify the volcanological concepts. Terrane Metals Corp. and Imperial Metals Corp. provided access to Mt. Milligan and Mt. Polley and also supported the project logistically

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