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Magma Fertility in the Guichon Creek and Nicola Batholiths

M. D'Angelo[1], P. Hollings[1], Miguel Alfaro[2]

[1]Lakehead University, Thunder Bay, Ontario, madangel@lakeheadu.ca; [2]Teck Resources Limited, Vancouver, British Columbia

Introduction

The Guichon Creek Batholith (GCB) is located in southcentral B.C., approximately 54km southwest of Kamloops. The GCB is located within the Quesnel Terrane of the Intermontane Belt, which trends northwest and extends from southern B.C. to the southwest Yukon territory (McMillan, 1976). The batholith is host to the Highland Valley Copper deposits and is being studied in order to characterise the unaltered signature of the host rocks. The magma fertility (based on oxidation and hydration state) of the GCB has been assessed and compared to the Upper Triassic Nicola Batholith (NB) located approximately 20km to the east.

Results

Plots of V/Sc, Sr/Y and Al_2O_3/TiO_2 versus SiO_2 (Figs. 1 to 3) were constructed to evaluate the relative fractionation of hornblende versus plagioclase and titanomagnetite as proxies for the hydration and oxidation state of the magmas. The sample suite was screened to include only the least altered samples using the methods outlined by Loucks (2014). Geochemical results were then compared to petrographic observations (Table 1).

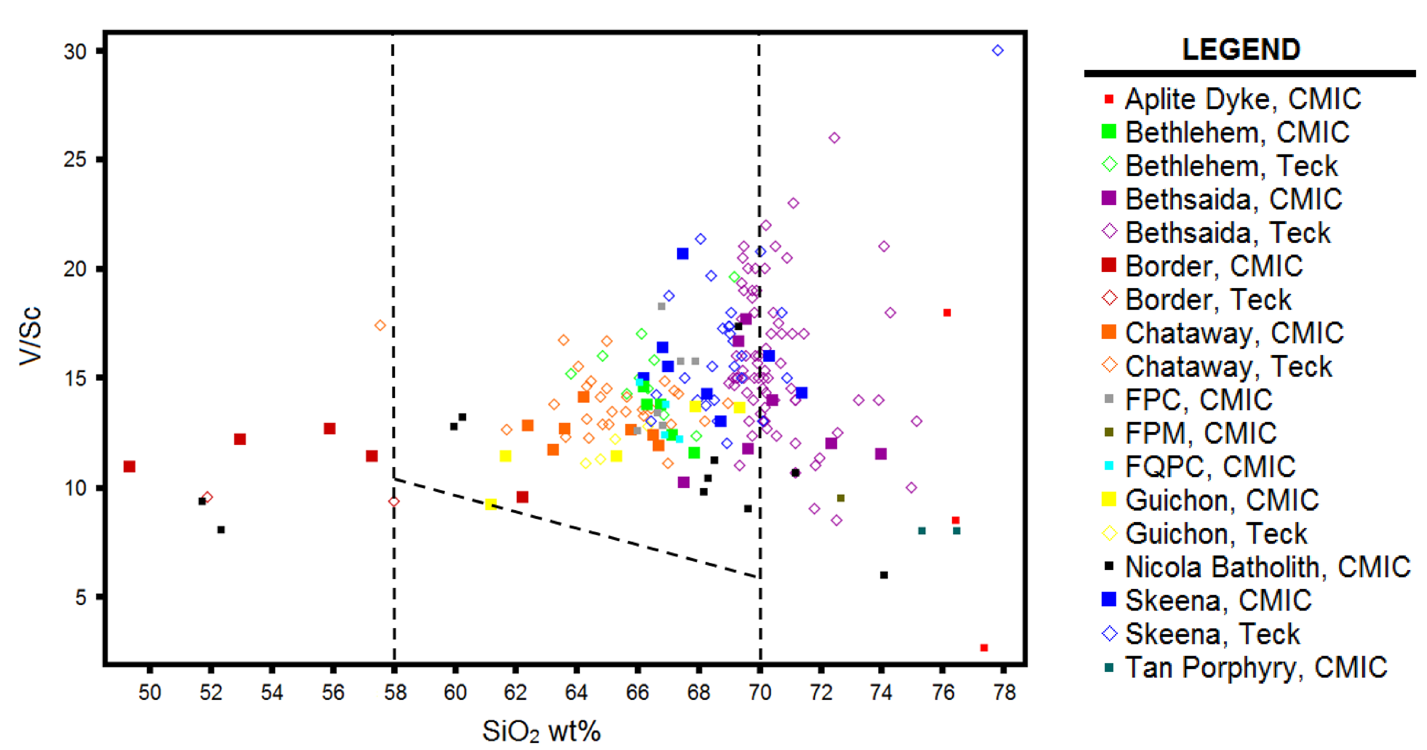

Figure 1 A plot of V/Sc vs. SiO_2 wt% for the Guichon Creek and Nicola Batholiths. Samples were screened for LOI <3.5 wt%. A modest increase in the V/Sc ratio indicates the depletion of Sc and concentration of V in the residual melt during crystallisation. The solid line is defined by the equation 32.5 – 0.385 x SiO_2 wt%. Samples that fall above this line and between 58 and 70 SiO_2 wt% are considered to represent fertile magmas prospective for porphyry copper mineralisation (Loucks, 2014). A legend for the symbols utilized on this and the subsequent figures is given.

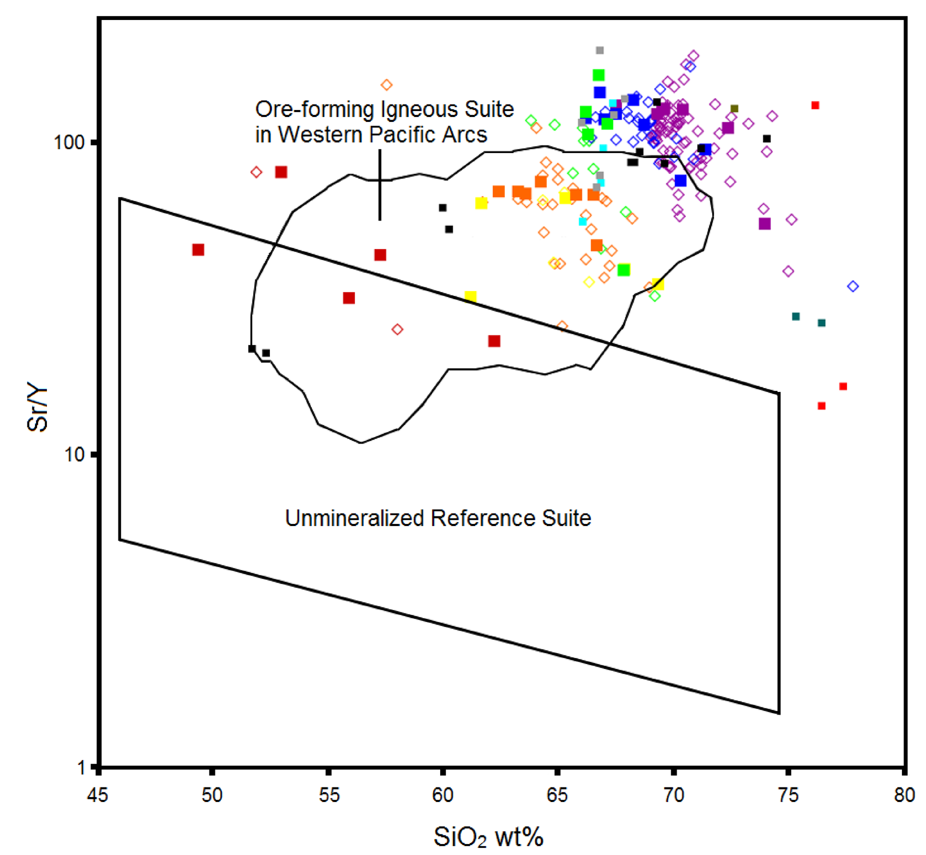

Figure 2 A plot of Sr/Y vs. SiO_2 wt% for the Guichon Creek and Nicola Batholiths. Samples were screened for LOI <3.5 wt%. An increase in the Sr/Y ratio indicates the depletion of Y and concentration of Sr in the residual melt during crystallisation. The majority of samples plot within or well above the ore-forming igneous suite defined by Loucks (2014).

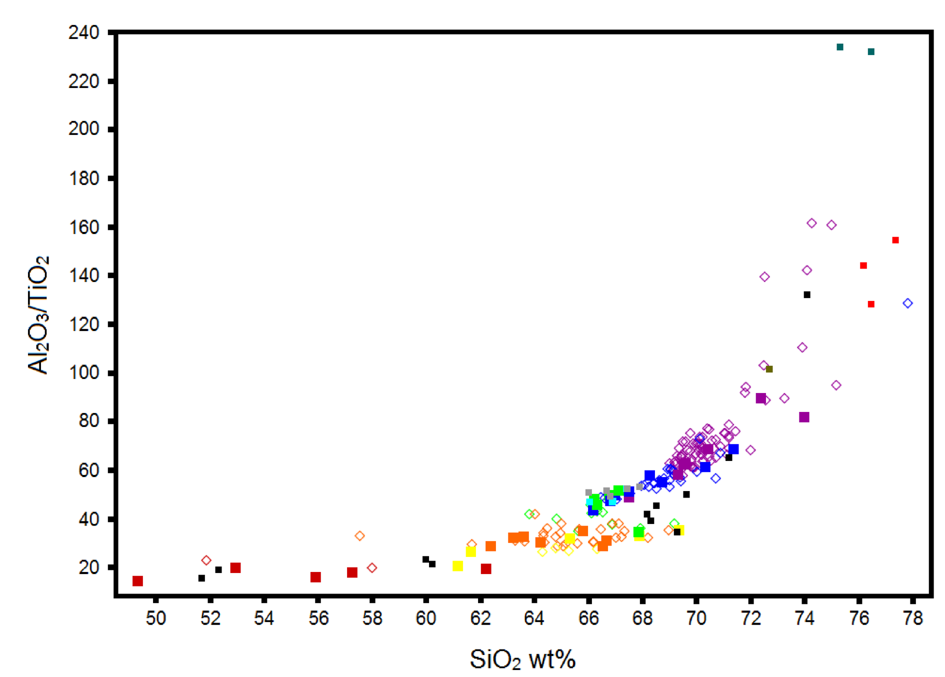

Figure 3 A plot of Al_2O_3/TiO_2 vs. SiO_2 wt% for the Guichon Creek and Nicola Batholiths. Samples were screened for LOI <3.5 wt%. A sharp increase in the Al_2O_3/TiO_2 ratio indicates the depletion of Ti and concentration of Al in the residual melt during crystallisation.

Facies	Modal Plagioclase	Modal Hornblende	Plagioclase/Hornblende Ratio
Bethsaida	32 to 55%	0.5 to 2%	18 to 110
Skeena	47 to 55%	3 to 5%	10 to 16
Bethlehem	50 to 55%	3 to 8%	11
Chataway	35 to 40%	9 to 13%	3 to 5

Table 1 Range of modal % plagioclase and hornblende compared with plagioclase/hornblende ratios for the Guichon Creek Batholith. Only facies for which detailed petrographic work has been completed are included. The relative amount of plagioclase to hornblende increases with increasing evolution.

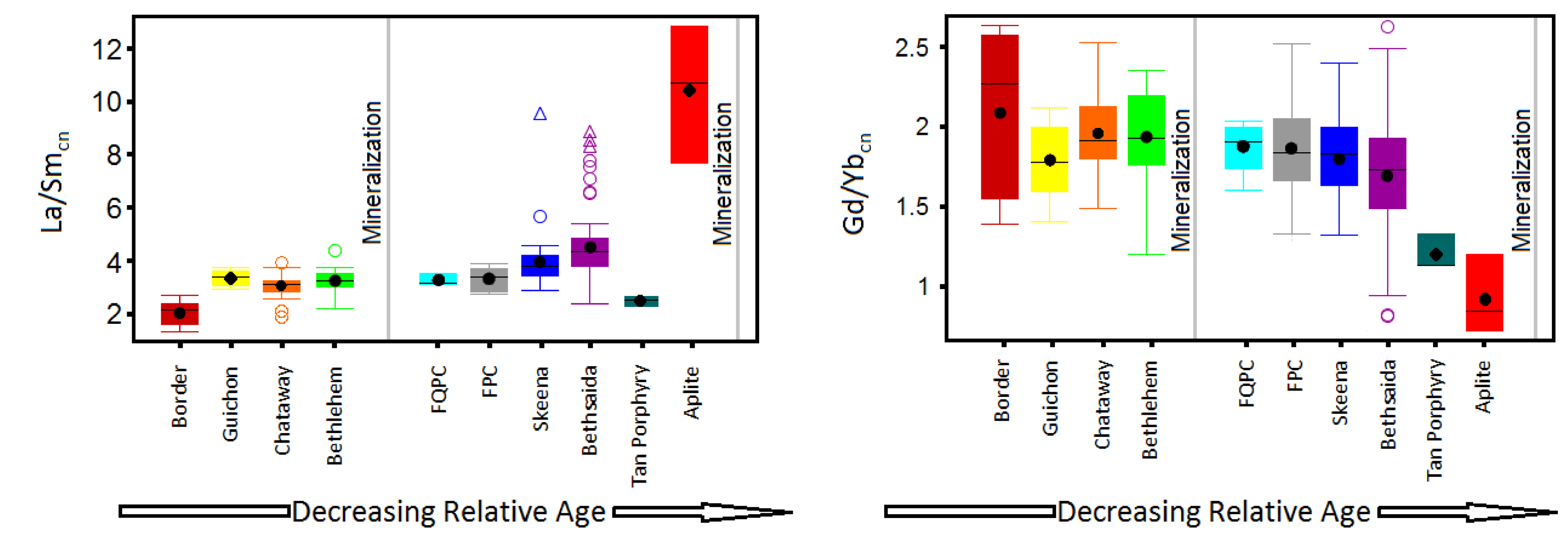

Figure 4 Tukey plots of $(La/Sm)_{cn}$ and $(Gd/Yb)_{cn}$ versus relative age for the intrusive facies of the Guichon Creek batholith. Data set is a compilation of data acquired for the Footprints project with additional unpublished data provided by Teck. La/Sm_{cn} ratios increase gradually with decreasing age peaking with emplacement of the Bethsaida facies and aplite dykes. Gd/Yb_{cn} ratios begin to decrease at the time of the first mineralization event. This change cannot be linked to the concurrent change in La/Sm_{cn} values and is likely due to fractionation of the MREEs into hornblende.

Conclusions

Increasing Al_2O_3/TiO_2 and Sr/Y (Figs. 2 and 3) ratios for the GCB and NB suggest an early suppression of plagioclase crystallization in favour of hornblende either due to high water contents in the parent magmas (5-6 wt% H_2O) or increased pressure of crystallization (Loucks, 2014). A trend of increasing V/Sc (Fig. 1) is consistent with hornblende fractionation in conjunction with suppression of titanomagnetite. It is apparent that both the Guichon Creek and Nicola Batholiths both represent arc magmas prospective for porphyry copper exploration.

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