Hunting an Invisible Intrusion: Redefining the Guichon Creek Border Phase at Craigmont

The Skarn to Porphyry Transition: Establishing geochronological and geochemical links between skarn and porphyry-type mineralization at Craigmont, British Columbia, Canada

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SCIENCE. EXPLORATION. DISCOVERY.

BACKGROUND

The Craigmont Cu-Fe skarn deposit is located in the Quesnel terrane of the Canadian Cordillera in southern British Columbia, adjacent to the Late Triassic Guichon Creek batholith, which hosts the calc-alkalic Highland Valley Cu-Mo porphyry district. Skarn-style mineralization is restricted to Upper Triassic Nicola Group carbonate-rich sedimentary and volcaniclastic rocks.

Previous research suggested the Guichon Creek batholith acted solely as a heat source to the deposit, while the Nicola Group Rocks are suggested to be the potential source of metals. Recent drilling, however, has revealed porphyry-type alteration within the Guichon Creek Border phase (diorite to quartz-diorite) adjacent to the historic Craigmont mine.

METHODS AND DISCUSSION

One objective of this study is to refine the lithological classification of the intrusive units in the Craigmont area; the Border phase ranges in mineralogical and chemical composition throughout the batholith and the causative intrusion for skarn mineralization has not yet been discovered at Craigmont. Selected core and outcrop samples of the Border phase and other intrusive units were analyzed for whole-rock lithogeochemistry. Results show a range in magmatic affinity and magmatic setting for samples previously grouped as Border phase, showing an intrusive complexity not previously recognized in this lithological grouping.

The LA-ICP-MS U-Pb zircon date of 216.1±1.1 Ma obtained in this study for the Border phase is older than all previously published dates, extending the formation of this phase to a 5 m.y. period from 216.1 Ma to 211.02 Ma. Similarly, the molybdenite Re-Os date of 214.1±0.9 Ma obtained in this study is older than published dates for the Highland Valley District (211-206 Ma), suggesting there is likely an earlier porphyry-type mineralizing event at Craigmont than previously recognized in the district. Although these two new dates overlap within uncertainty, this does not yet definitively link them as related to the same mineralizing event. Further petrography and U-Pb geochronology on intrusive rocks and U-Pb garnet geochronology of skarn mineralization at Craigmont will be conducted to fully define the links between skarn, porphyry, and the Guichon Creek batholith.

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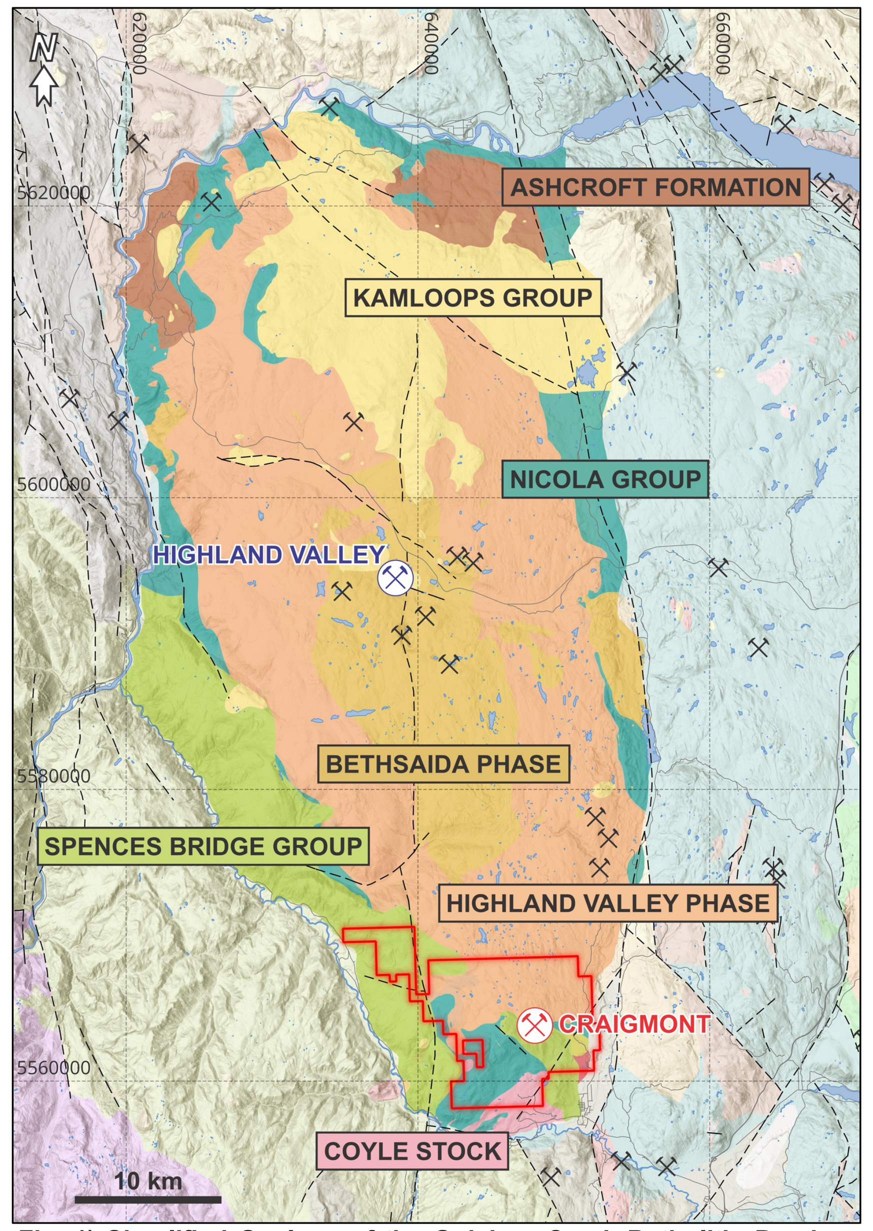


Fig. 1) Simplified Geology of the Guichon Creek Batholith. Previous interpretations of intrusive units divided the batholith into three main magmatic pulses, grouped as the pre-mineral Highland Valley group, the syn-mineral Bethsaida group, and late porphyry dikes. Craigmont is adjacent to the oldest unit in the Highland Valley group: the Border phase. (data from Geological Survey of Canada; W.J. McMilllan, R.G. Anderson, R. Chan, and W. Chow)

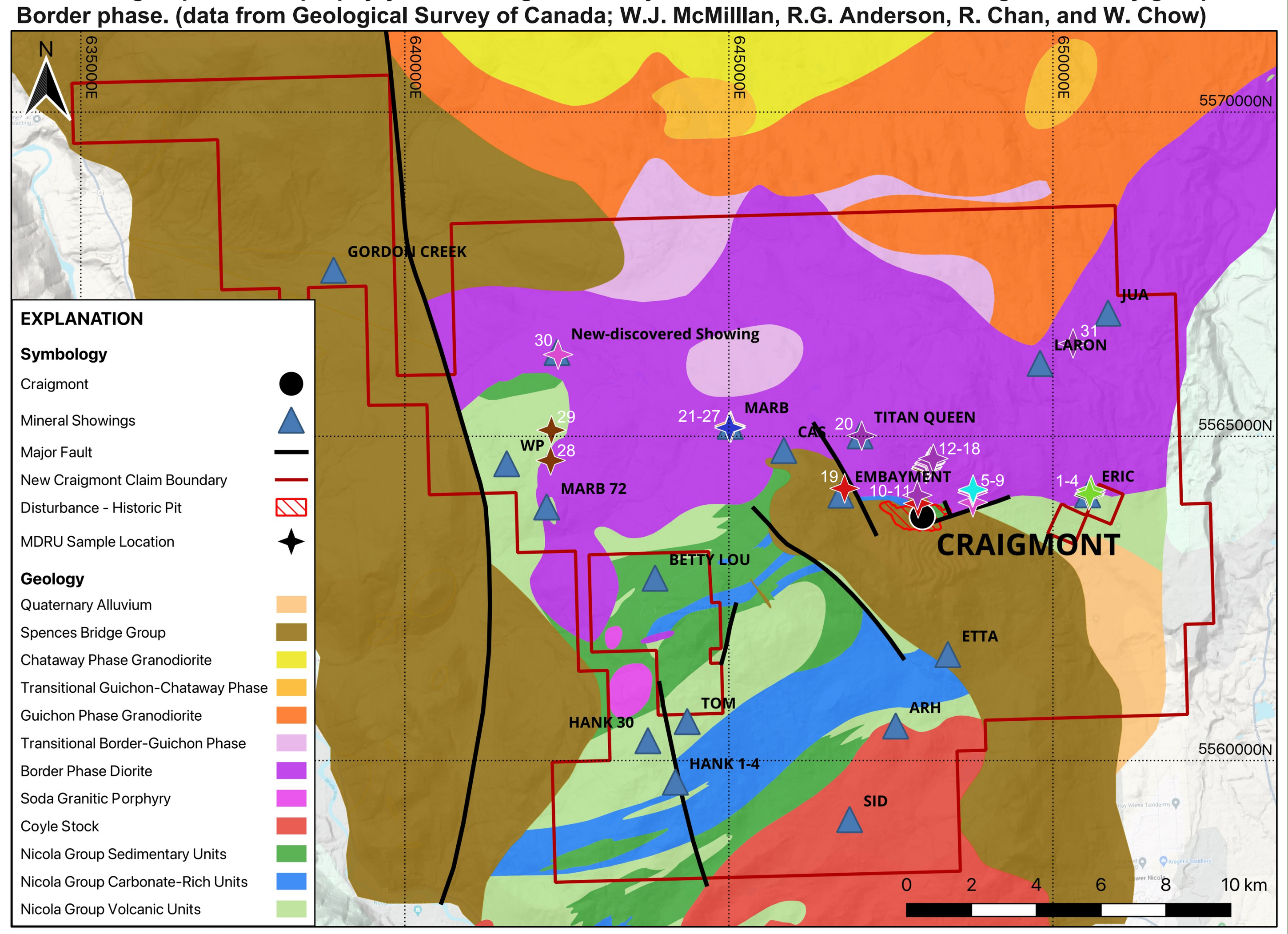


Fig. 2) Geology Map of the New Craigmont Property. The Craigmont mine sits at the southern contact of the Guichon Creek batholith and the Nicola Group and the new claim area includes the Border and Guichon phases of the batholith. (data from Geological Survey of Canada; W.J. McMilllan, R.G. Anderson, R. Chan, and W. Chow)

Geochronology of the Guichon Creek Batholith

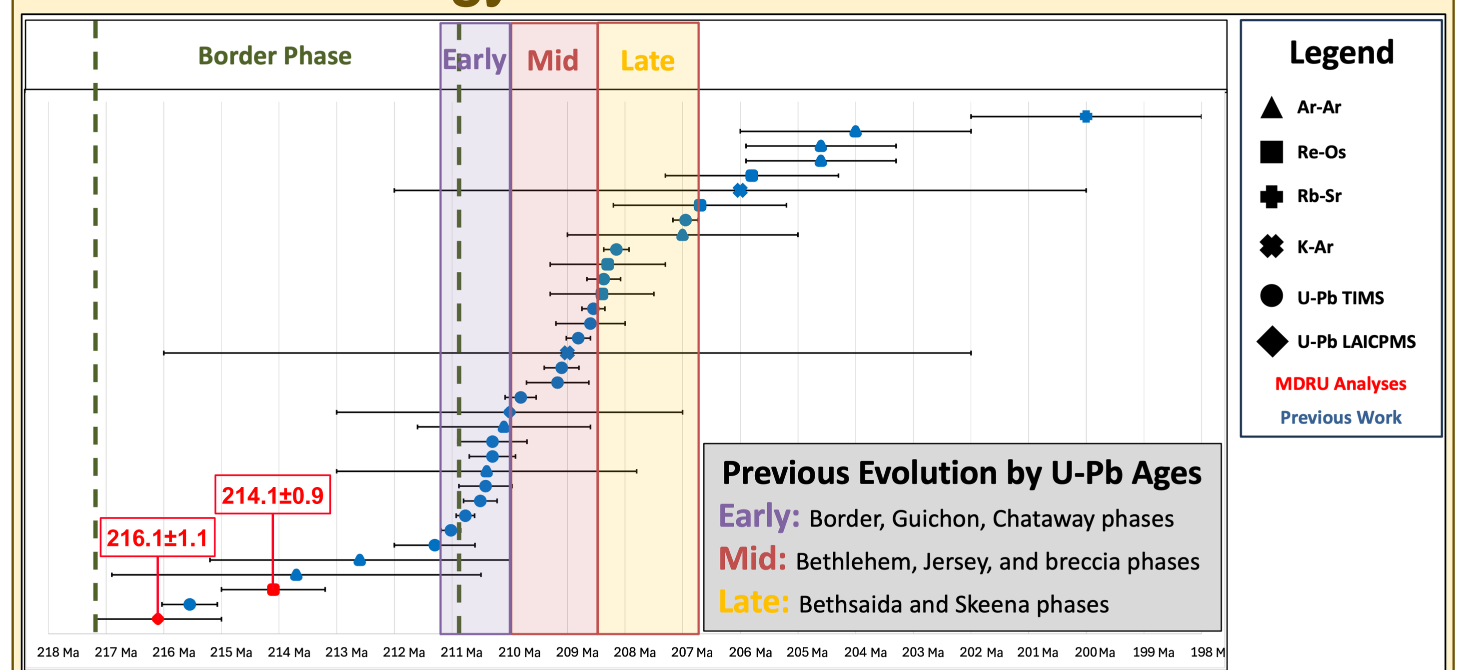


Fig. 3) Compiled geochronology of the Guichon Creek batholith, sources listed below. Previous CA-ID-TIMS U-Pb zircon studies in the Highland Valley District constrained the batholith to a ~4 m.y. age range from 211.02 Ma to 206.95 Ma. Subsequent work done by the GSC (CA-ID-TIMS: 2017) and MDRU (LA-ICP-MS: 2023) have obtained ages of 215.55±0.48 Ma and 216.1±1.1 Ma, respectively, for the Border phase, extending its crystallization period from ~0.5 m.y. to ~5 m.y. and the entire Guichon Creek batholith from ~4 m.y. to ~9 m.y.

Ash, C.H., Reynolds, P.H., Creaser, R.A., and Mihalynuk, M.G., 2007, 40Ar/39Ar and Re O isotopic ages for hydrothermal alteration and related mineralization at the Highland Valley Cu-Mo deposit (NTS 092I), southwestern British Columbia: Geoscience BC Report 2007-1, p. 19–24.

Chrismas, L., Baadsgaard, H., Folinsbee, R. E., Fritz, P., Krouse, H. R., & Sasaki, A. (1969). Rb/Sr, S, and O isotopic analyses indicating source and date of contact metasomatic copper deposits, Craigmont, British Columbia, Canada. Economic Geology, 64(5), 479–488.

MDRU, 2023, unpublished.

Michael D'Angelo, Alfaro Miguel, Pete Hollings, Kevin Byrne, Stephen Piercey, Robert A. Creaser; Petrogenesis and Magmatic Evolution of the Guichon Creek Batholith: Highland Valley Porphyry Cu ± (Mo) District, South-Central British Columbia. *Economic Geology* 2017; 112 (8): 1857–1888.

Mortimer, N., Van Der Heyden, P., Armstrong, R.L., and Harakal, J., 1990, U-Pb and K-Ar dates related to timing of magmatism and deformation in the Cache Creek terrane and Quesnellia, southern British Columbia: Canadian Journal of Earth Sciences, v. 27, p. 117–123.

Whalen, J.B., Davis, W.J., and Anderson, R.A., 2017. Temporal and Geochemical Evolution of the Guichon Creek Batholith and Highland Valley Porphyry Copper District, British Columbia: Implications for Generation and Tectonic Setting of Porphyry Systems: Geological Survey of Canada, Open File 8334, 49 p.

Whole-Rock Geochemistry

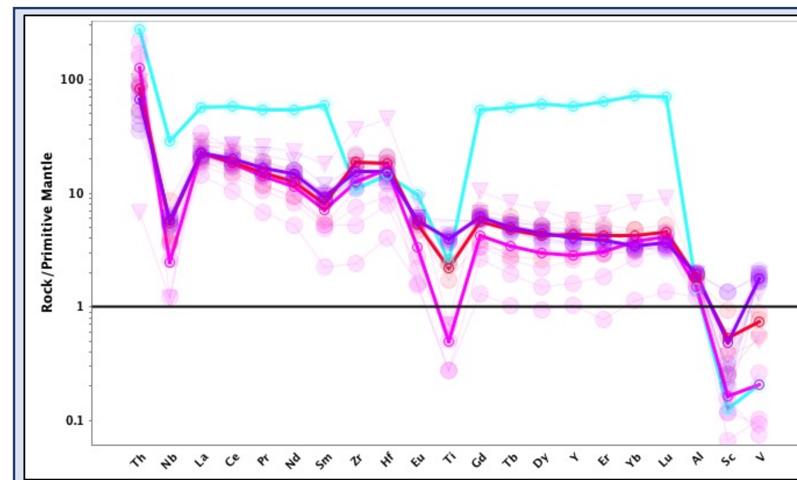


Fig. 4A) Immobile element diagram of calc-alkaline samples normalized against primitive mantle values (Sun and McDonough, 1989). Solid lines are mean values.

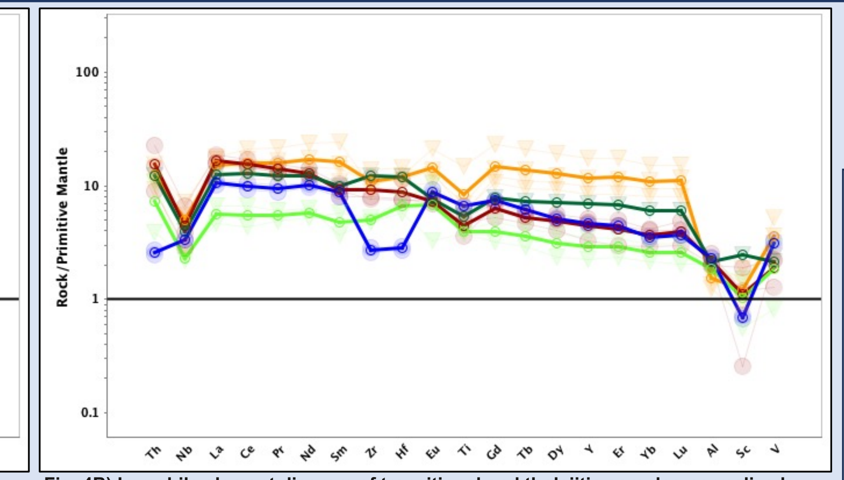


Fig. 4B) Immobile element diagram of transitional and tholeiitic samples normalized against primitive mantle values (Sun and McDonough, 1989).

Color	Shape
Border Phase X	Least-altered
Border Phase Y	Altered
Border Phase Z	
Border Phase E	
Border Phase F	
Felsic Pegmatite Dikes	
REE-Enriched Felsic Dike	
Mafic Intrusions	
Basalt	

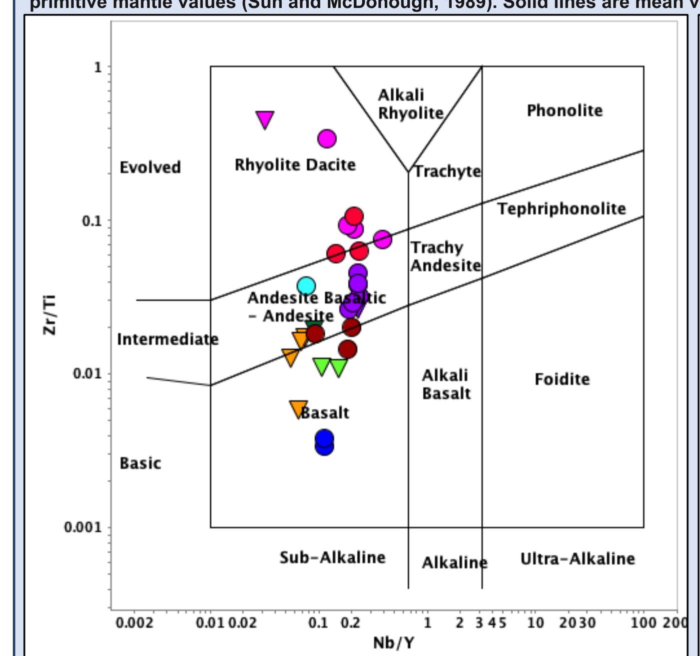


Fig. 4C) Zr/Ti vs Nb/Y (after Pearce 1996) for immobile element rock type classification.

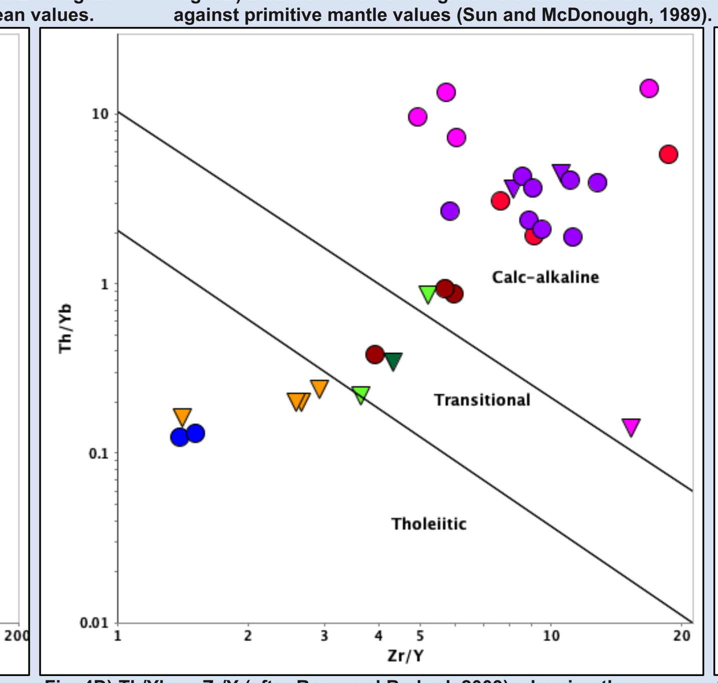


Fig. 4D) Th/Yb vs Zr/Y (after Ross and Bedard, 2009), showing the range in magmatic affinity for subalkaline rocks at Craigmont.

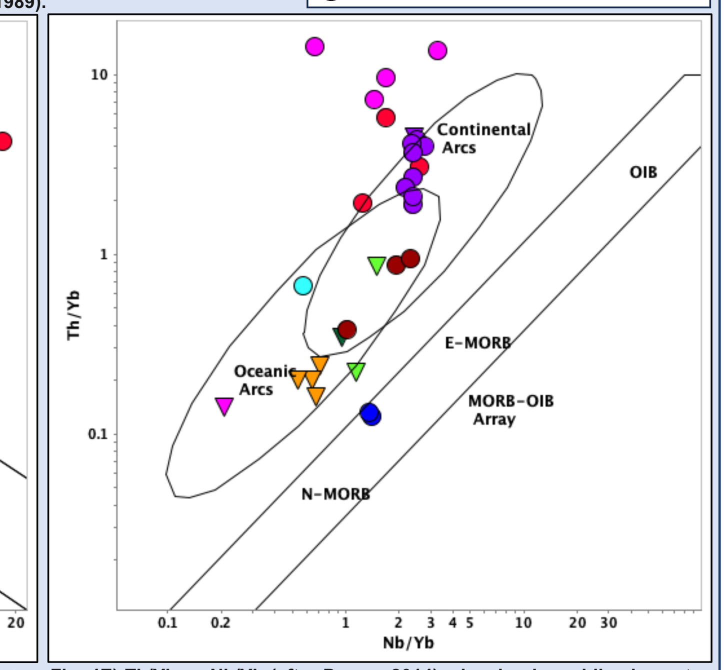
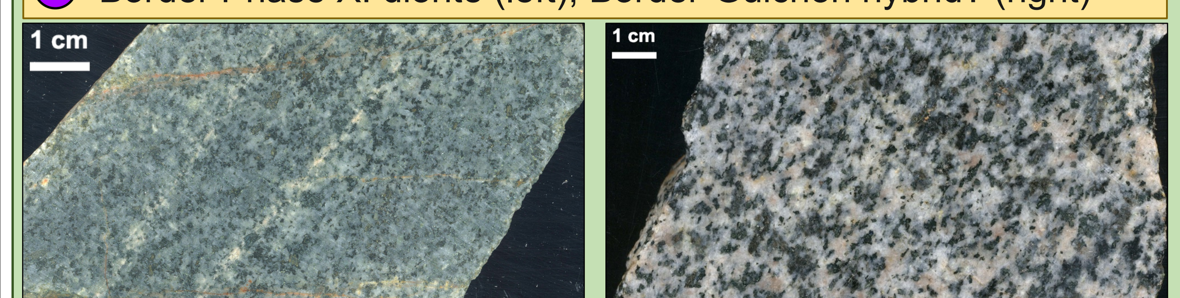


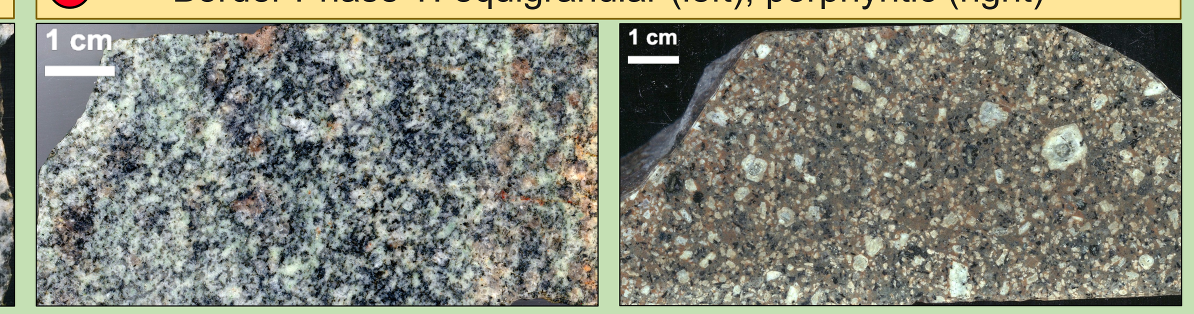
Fig. 4E) Th/Yb vs Nb/Yb (after Pearce 2014), showing immobile element variation that corresponds to differing tectono-magmatic processes.

Representative Rock Scans of Intrusive Lithologies at Craigmont as Classified by Lithogeochemistry

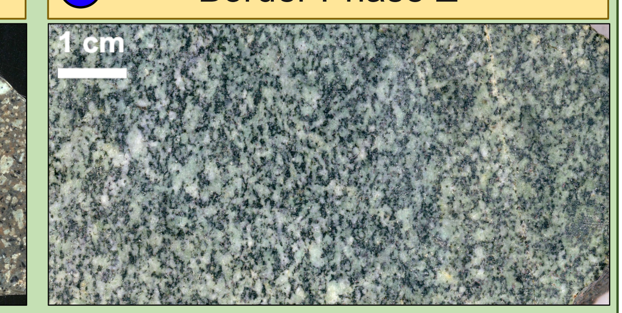
Border Phase X: diorite (left), Border-Guichon hybrid? (right)



Border Phase Y: equigranular (left), porphyritic (right)

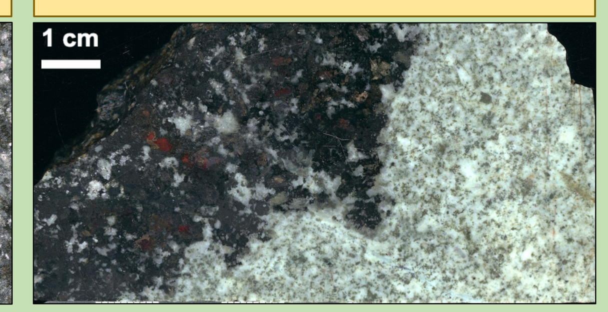


Border Phase Z



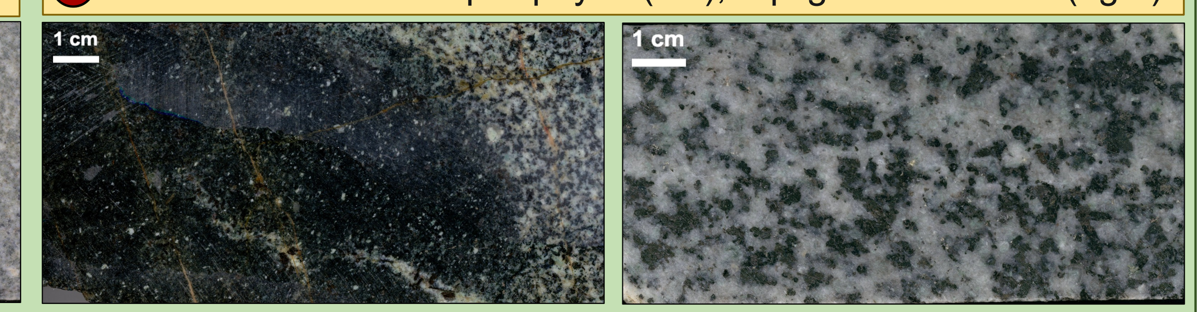
Border Phase E

Border Phase E-F Contact

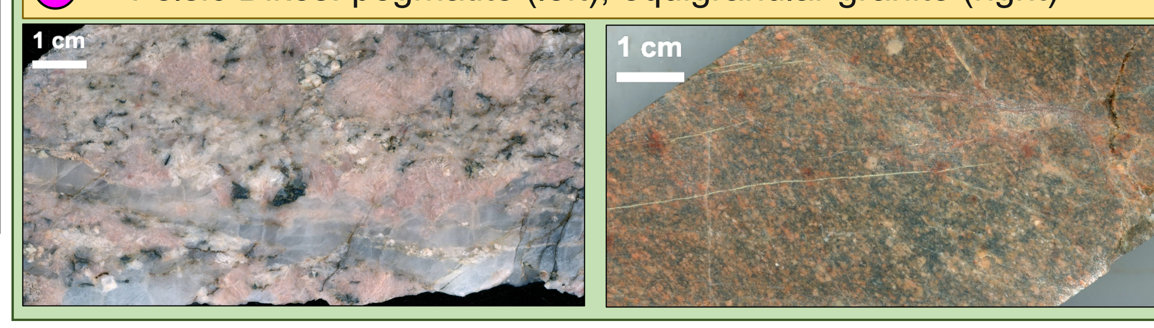


Border Phase F

Mafic Intrusions: feldspar-phyric (left), equigranular diorite (right)



Felsic Dikes: pegmatite (left), equigranular granite (right)



High-REE Felsic Dike

Basalt: unaltered (left), epidote-chlorite-titanite altered (right)

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