Stratigraphic and Lithological Constraints of Late Cretaceous Volcanic Rocks in the TREK Project Area, Central British Columbia (NTS 093E)

MDRU
Mineral Deposit Research Unit

Geoscience BC

R.S. Kim[1], C.J.R. Hart[1], J. J. Angen[1]

[1] Mineral Deposit Research Unit (MDRU), The University of British Columbia

I. Introduction

The host rocks for the Blackwater orebody, and other epithermal occurrences in the region, are Late Cretaceous Kasalka Group volcanic rocks (Christie et al., 2014; Looby, 2015); consequently this volcanic rock package is highly prospective. However, extensive Eocene and Neogene magmatism and glacial till obscure older bedrock exposure, leading to considerable uncertainty in the distribution of the Kasalka Group across central BC.

This project is a joint initiative between the Mineral Deposit Research Unit (MDRU) at the University of British Columbia (UBC) and Geoscience BC to characterize the Kasalka Group and to distinguish Late Cretaceous volcanic rocks from Jurassic and Eocene volcanic suites in the area. The results from targeted, regional 1:20 000 scale bedrock mapping, aided by high-resolution geophysical surveys (Aeroquest Airborne Ltd. 2014, Angen et al., 2015), along with geochronological and geochemical analysis of field samples, will improve identification of the Kasalka Group rocks, thereby aiding in future exploration targeting initiatives within the TREK project area.

View of Top Lake (center of photo), looking southwest. Photo taken from central-western TREK project area.

II. Geological Setting & Study Area

The Interior Plateau region lies within the Intermontane Belt superterrane, underlain by the Paleozoic to Mesozoic Stikine and Quesnel accreted arc terranes and Cache Creek oceanic terrane (Figure 1, Monger & Price, 2002).

The underlying units in the TREK area (Figure 1) are Late Triassic to Middle Jurassic arc volcanic rocks of the Stikine terrane and their erosional products. Overlap basinal assemblages of the Late Jurassic to mid-Cretaceous Bowser Lake Group and the Early Cretaceous Skeena Group (Riddell, 2011) are also exposed in the northern TREK area. Episodic continental volcanic arcs through the Late Cretaceous to Eocene produced the Kasalka, Ootsa Lake and Endako groups (Evenchick, 1991). Younger rocks exposed in central BC are dominated by Eocene volcanics and basalt flows of the Neogene Chilcotin Group (Bevier et al., 1983).

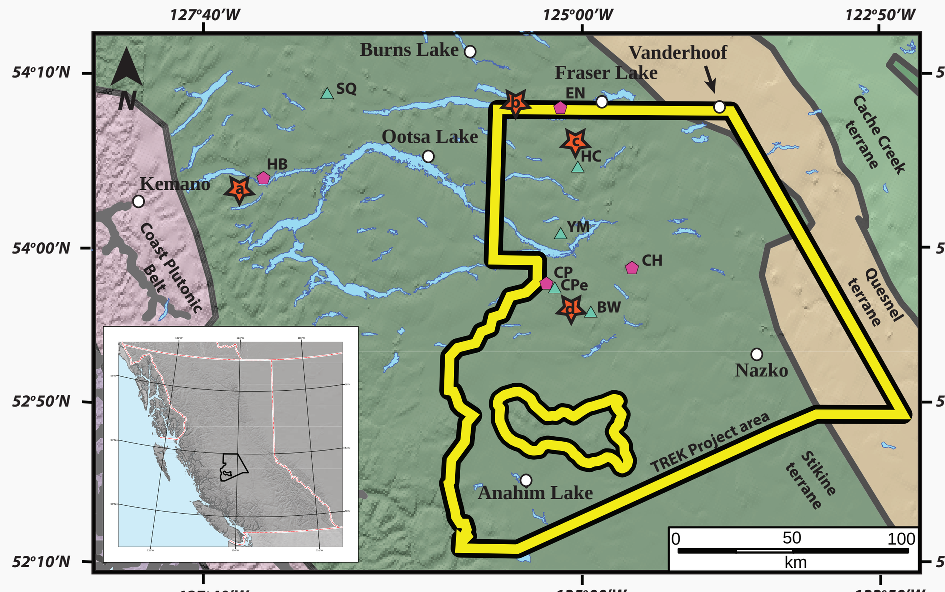
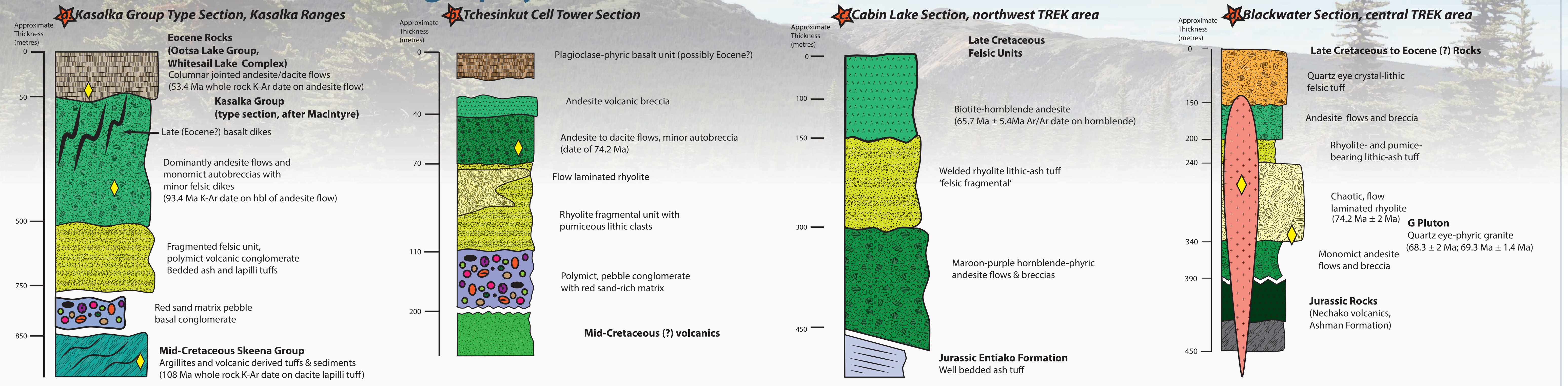


Figure 1. The TREK project area, central British Columbia, modified from Colpron et al. (2007). Stars indicate the locations of stratigraphic sections (See Figure 2) that are based on mapping of Late Cretaceous Kasalka Group rocks. Green triangles indicate locations of epithermal mineralization hosted in Late Cretaceous volcanic packages: BW, Blackwater; CPe, Capoose; HC, Holy Cross; SQ, Silver Queen; YM, Yellow Moose. Pink pentagons indicate porphyry deposits in the region. Jurassic: EN, Endako; Cretaceous: CP, Capoose; HB, Huckleberry; Eocene: CH, Chu.

Continuous stratigraphic exposures of all units are rare in the project area. Late Cretaceous to Eocene stratigraphy is presented to correlate the lithological similarities observed at the regional scale. The Kasalka Group type section in the Tahtsa Lake area was sampled to facilitate geochemical and geochronological comparisons with examples of the Kasalka Group further to the east.

III. Late Cretaceous Stratigraphy



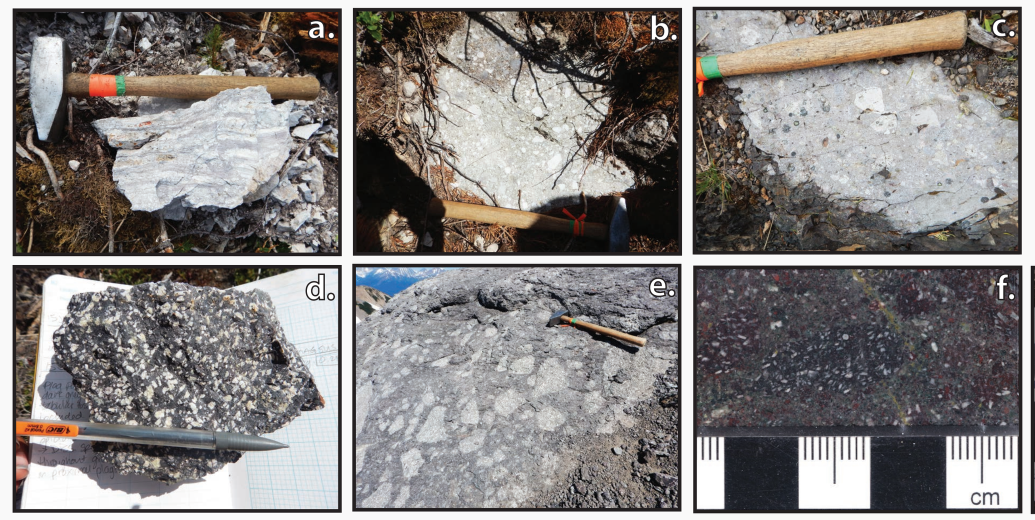


Figure 3. Examples of lithological units of the Kasalka Group: a) flow-banded rhyolite west of Blackwater; b) 'felsic fragmental', flow-banded rhyolite clast-dominated unit at Blackwater; c) andesitic volcanic breccia dominated by felsic clasts; d) plagioclase-phyric andesite; e) monomict, andesitic volcanic breccia from Kasalka type section; f) polymict, plagioclase-hornblende–phyric andesite breccia sampled from north of the Yellow Moose showing; g) pebble conglomerate at the base of the Tchesinkut section.

*Figure 2. Stratigraphic schematics from the Kasalka type section and other localities in the study area, compiled from observations made during the 2014 and 2015 field seasons: **a)** Type section stratigraphy from the Kasalka Range in the Tahtsa Lake area (NTS 093E), K/Ar dates compiled in Diakow (2006), modified from MacIntyre (1985); **b)** Stratigraphic schematic from Tchesinkut cell tower, north of François Lake, U/Pb date from Grainger (2000); **c)** Stratigraphic schematic from the Cabin Lake area, in the northwest portion of the TREK project area, south of François Lake; Ar/Ar date from Friedman et al. (2001); **d)** Stratigraphy west of Blackwater deposit, north of the access road, ages from R. Whiteaker (pers. comm., 2015).*

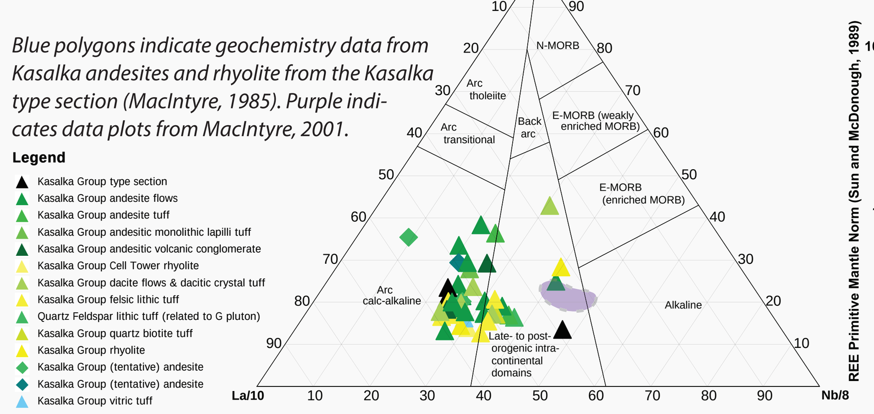
Fieldwork included the mapping of four localities (Figure 1). The first location (Figure 2b), was mapped as part of fieldwork conducted in 2014 and described in Kim et al. (2015). The 2015 field season allowed for three additional localities (Figure 2a, c, d) to be mapped. The compilation of stratigraphic successions across the northern TREK area and at the Kasalka Group type sections show general trends. Figure 2 shows a general trend across each section of a middle felsic unit being under- and overlain by andesite breccias and flows from east to west. This package of felsic and intermediate rocks is also shown to overlie Jurassic Ashman Formation and mid-Cretaceous Skeena Group volcano-sedimentary packages, this is especially noted near Blackwater (Figure 2d). The basal conglomerate described in the Kasalka Group type section is not continuous, and is documented west of the TREK area.

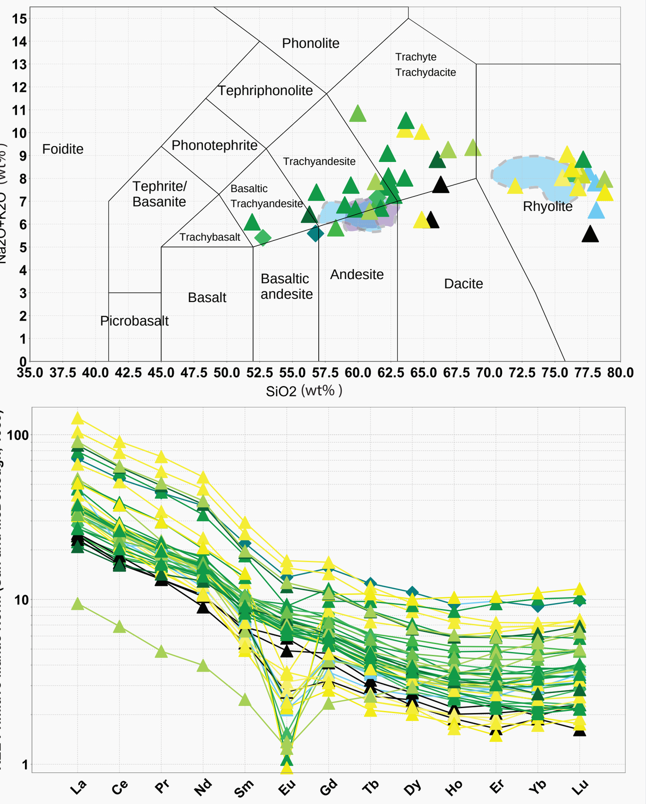
IV. Lithogeochemistry

Figure 4. Compilation of whole rock geochemistry data collected from Late Cretaceous volcanic and intrusive rocks from stratigraphic section localities (Figure 2). Samples collected in the 2014 and 2015 field seasons.

a) tectonic classification ternary plot, after Cabanis and Lecolle (1989);
b) primitive mantle-normalized rare-earth element (REE) pattern (Sun and McDonough, 1989) for andesite and basaltic samples (top) and for rhyolite and crystal tuff samples (bottom);
c) primitive mantle-normalized REE pattern (Sun and Mc-Donough, 1989); c) total alkali/silica (TAS) classification for volcanic rocks

Blue polygons indicate geochemistry data from Kasalka andesites and rhyolite from the Kasalka type section (MacIntyre, 1985). Purple indicates data plots from MacIntyre, 2001.





V. Geochronology

Three age populations are identified by various dating methods have been applied to constrain the Kasalka Group (K-Ar on whole rock, biotite, and/or hornblende; $^{40}Ar/^{39}Ar$ on hornblende; U-Pb on zircon. Most of the dating conducted at the type section was by K-Ar methods (Figure 5).

More recent geochronology results from zircon show the age range for felsic components of the Kasalka Group to be from ca. 74 to 70 Ma (Friedman et al., 2001; Ferbey and Diakow, 2012; Looby, 2015; R. Whiteaker, pers. comm., 2015). Although the age ranges of these recent dates narrow the timing constraints, correlation to the units and their respective timing is sparse. Continued work on U-Pb and $^{40}Ar/^{39}Ar$ samples are anticipated to provide further confidence and timing constraints.

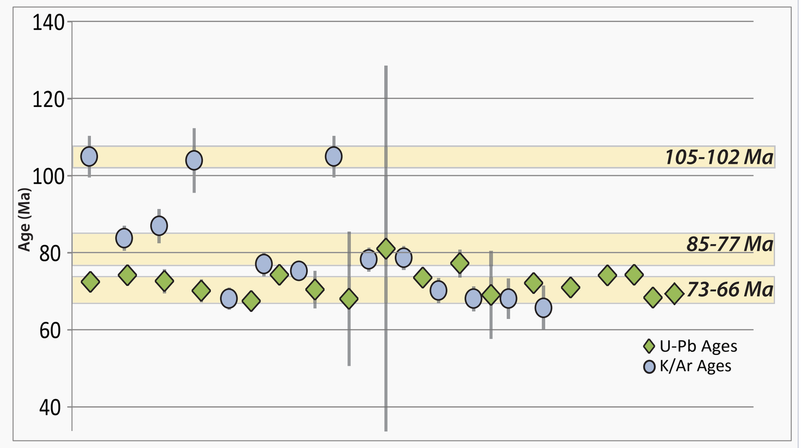


Figure 5. Compiled histogram of published ages for Kasalka Group and similar volcanic suites. Dating methods include K-Ar on whole rock, biotite, and hornblende (MacIntyre, 1985; Leitch et al., 1991; Diakow et al., 1997; Friedman et al., 2001), and U/Pb on zircon (Grainger, 2000; Friedman et al., 2001; Ferbey and Diakow, 2012; McClenaghan, 2013; Looby, 2015).

VI. Conclusions and Future Work

The Kasalka Group is observed to be a volcano-sedimentary sequence, dominated by a series of fragmental and coherent volcanic rocks overlying clastic sedimentary rocks. Results from targeted regional bedrock mapping in the northern TREK project and surrounding area indicates that this unit can be highly variable in places. This can be attributed to the distribution of localized volcanic centers across the region. Recent logging and forest fires in the region have improved bedrock exposure, and have contributed to a reclassification of felsic and fragmental units to the Late Cretaceous based on lithological similarities, stratigraphic relationships, and further support from new geochronology data.

An example of recently logged areas and terrain near the Blackwater Camp.

A regional compilation of stratigraphic sections across the northern and central TREK areas , and comparisons to the Kasalka Group type section show broad similarities in rock units. Figure 2 shows the trend across each section of a middle felsic coherent and/or fragmental unit being under- and overlain by andesite breccias and flows. This package of felsic and intermediate rocks is observed to overlie Jurassic Ashman Formation and mid-Cretaceous Skeena Group volcano-sedimentary packages west of the Blackwater orebody and Kasalka type section, respectively. Kasalka Group rocks in proximity to Jurassic stratigraphy may be an indicator for mineral potential, as is observed at Blackwater. A crystalline quartz-rich felsic tuff is also noted to be exposed as a 'capping' succession that also shows lithological similarities to proximal Late Cretaceous intrusive bodies.

Published age data from the Kasalka type section indicate ages ranging from ~87-83 Ma, with the majority of dates from whole rock and mineral K-Ar methods. . In the TREK area, reported Kasalka Group ages range from 74-70 Ma both within and surrounding the Blackwater orebody. This may reflect an eastward-younging magmatic front across the Stikine terrane through the Late Cretaceous.

Further geochronology results from $^{40}Ar/^{39}Ar$ on hornblende and U-Pb on zircon grains are underway to provide further age constraint to mapped stratigraphic sections shown in Figure 2. Ongoing work on whole rock lithogeochemistry on collected samples will provide insight into timing, lithologic characteristics, and petrogenesis.

References

Aeroquest Airborne Ltd.(2014): Fixed wing magnetic geophysical survey, TREK project, Interior Plateau/Nechako Region, British Columbia; Geoscience BC, Report 2014-04, 40 p.
Angen, J.J., Logan, J.M., Hart, C.J.R. and Kim, R. (2016): TREK geological mapping project, year 2: update on bedrock geology and mineralization in the TREK project area, central British Columbia (parts of NTS 093B, C, F, G); in Geoscience BC Summary of Activities 2015, Geoscience BC, Report 2016-1
Angen, J., Westberg, E., Hart, C., Kim, R. and Raley, C. (2015): TREK geology project: recognizing Endako Group and Chilcotin Group basalts from airborne magnetic data in the Interior Plateau region, south-central British Columbia (NTS 093B, C, F, G); Geoscience BC, Report 2015-1, p. 21–32
Bevier, M.L. (1983): Regional stratigraphy and age of Chilcotin Group basalts, south-central British Columbia; Canadian Journal of Earth Sciences, v. 20, no. 4, p. 515–524.
Christie, G., Lipiec, I., Simpson, R.G., Horton, J. and Bromtraeger B. (2014): Blackwater gold project British Columbia: NI 43-101 technical report on feasibility study; New Gold Inc., 2014, 336 p.
Diakow, L.J., Webster, I.C.L., Richards, T.A. and Tipper H.W. (1997): Geology of the Fawnie and Nechako ranges, southern Nechako Plateau, central British Columbia (98F/2, 3, 6, 7); BC Geological Survey, Paper 1997-2, p. 7–30
Diakow , L.J. (2006): Geology of the Tahtsa Ranges between Eutsuk Lake and Morice Lake, Whitesail Lake map area, west-central British Columbia: parts of NTS 93E/5, 6, 7, 9, 10, 12, 13, 14 and 15; BC Ministry of Energy and Mines, BC Geological Survey, Geoscience Map 2006-5, scale 1:50 000
Evenchick, C.A. (1991): Geometry, evolution and tectonic framework of the Skeena Fold Belt, north central British Columbia; Tectonics, v. 10, p. 527–546
Ferbey, T. and Diakow, L.D. (2012): U-Pb Isotopic ages from volcanic rocks near Ootsa Lake and François Lake, west-central British Columbia; in Geological Fieldwork 2011, BC Ministry of Energy and Mines, BC Geological Survey, Paper 2012-1, p. 149–156
Friedman, R.M., Diakow, L.J., Lane, R.A. and Mortensen, J.K. (2001): New U-Pb age constraints on latest Cretaceous magmatism and associated mineralization in the Fawnie Range, Nechako Plateau, central British Columbia; Canadian Journal of Earth Sciences, v. 38, p. 619–637
Grainger, N. (2000): Petrogenesis of Middle Jurassic to Miocene magmatism within the Nechako Plateau, central British Columbia: insight from petrography, geochemistry, geochronology and tracer isotope studies; University of Alberta, M.Sc. thesis, 138 p.
Kim, R., Hart, C., Angen, J. and Westberg, E. (2015): Characterization of Late Cretaceous volcanic suites in the TREK Project area, Central British Columbia (NTS 093F, K); in Geoscience BC Summary of Activities 2014, Geoscience BC, Report 2015-1, p. 33–40
Leitch, C.H.B., Hood, C.T., Cheng, X.-L. and Sinclair, A.J. (1991): Tip Top Hill volcanics: Late Cretaceous Kasalka Group rocks hosting Eocene epithermal base- and precious-metal veins at Owen Lake, west-central British Columbia; in Canadian Journal of Earth Sciences, v. 29, p. 854–864
Looby, E.L. (2015): The timing and genesis of the Blackwater gold-silver deposit, central British Columbia: constraints from geology, geochronology and stable isotopes; University of British Columbia, M.Sc. thesis, 172 p.
MacIntyre, D.G. (1977): Evolution of upper Cretaceous volcanic and plutonic centres and associated porphyry copper occurrences Tahtsa Lake area, British Columbia; University of Western Ontario, Ph.D. thesis, 216 p.
MacIntyre, D.G. (1985): Geology and mineral deposits of the Tahtsa Lake District, west central British Columbia; BC Ministry of Energy and Mines, BC Geological Survey, Bulletin 75
MacIntyre, D.G. (2001): The Mid-Cretaceous Rocky Ridge Formation—a new target for subaqueous hot-spring deposits (Eskay Creek-type) in Central British Columbia; BC Geological Survey, Paper 2001-1, p. 253–268.
McClenaghan, L. (2013): Geology and genesis of the Newton bulk-tonnage gold-silver deposit, central British Columbia; University of British Columbia, M.Sc. thesis, 205 p.
Monger, J. and Price, R. (2002): The Canadian Cordillera: geology and tectonic evolution; Canadian Society of Exploration Geophysicists Recorder v. 27, no. 2, p. 17–36
Riddell, J. (2011): Lithostratigraphic and tectonic framework of Jurassic and Cretaceous Intermontane sedimentary basins of south-central British Columbia; Canadian Journal of Earth Sciences, v. 48, p. 870–896

Acknowledgements

The TREK project is a collaboration with the Mineral Deposit Research Unit (MDRU) at the University of British Columbia and Geoscience BC. The authors acknowledge and thank A. Albano for his assistance in the field. The authors are also grateful to J. Lipske, R. Whiteaker, and others from New Gold, Inc. for thoughtful geological discussions, insights in the field, and access to core and data. R. Kim graciously thanks Geocience BC for providing generous financial support. The authors thank L. McClenaghan for thoughtful review of the accompanying manuscript to this poster.

Contact:

Rachel S. Kim B.Sc.
M.Sc. Candidate
Email: rsykim@eos.ubc.ca

Mineral Deposit Research Unit (MDRU)
The University of British Columbia
2020-2207 Main Mall
Vancouver, BC V6T 1Z4

Project funding provided by: Geoscience BC

UBC a place of mind
THE UNIVERSITY OF BRITISH COLUMBIA