Intrusion-related base- and precious-metal potential, Boundary District, southern British Columbia (082E1/2)

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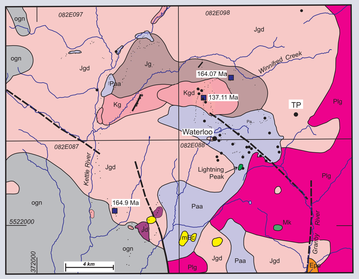
Geoscience BC

Lightning Peak



Geology of the Lightning Peak camp after Cairnes (1930); Tempelman-Kluit (1989) and Hoy et al. (2020).

Neogene
- Kallis formation

Eocene
- Ec Coryell syenite
- Em Penticton group

Paleocene
- Pg Okanagan batholith
- Paleocene/Cretaceous (?)
- Pg pink, massive granite
- Pgd porphyritic granodiorite, granite

Jurassic
- Jgd granodiorite, (granite)
- Jm monzonite; granite (porphyritic)
- Jd diorite

Paleozoic
- Paa metavolcanic rocks; metasediments

Age unknown
- ogn Okanagan gneiss

- mineral deposit / occurrence
- U-Pb zircon date
- fault: defined, approximate
- geological contact

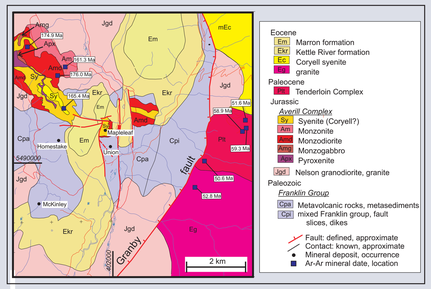

Polymetallic vein dump (AU deposit, MINFILE 082ENE027)


NNE trending Ag-Au-Pb-Zn Potossi vein

Lightning Peak: discussion

1. Camp mineralization is zoned, with typically west-trending Ag-base metal veins in the south and more northerly gold-rich mineralization farther north.
2. Mineralization is in Jurassic and Cretaceous stocks, and in Paleozoic basement.
3. Mineralization generally trends northwest, at intersection of N and NW structural zones.

Franklin camp



Eocene
- Em Marron formation
- Ekr Kettle River formation
- Ec Coryell syenite
- Eg granite

Paleocene
- Ept Tenderloin Complex

Jurassic
- *Averill Complex*
- Sy Syenite (Coryell?)
- Am Monzonite
- Mz Monzodiorite
- Mzg Monzogabbro
- Mpx Pyroxenite
- Jgd Nelson granodiorite, granite

Paleozoic
- *Franklin Group*
- Cpi metavolcanic rocks, metasediments
- Cpi mixed Franklin group, fault slices, dikes

- Fault: defined, approximate
- Contact: known, approximate
- Mineral deposit, occurrence
- Ar-Ar mineral date, location

Geology of the Franklin mining camp and surrounding area; modified from Keep (1989) and Drysdale (1915).

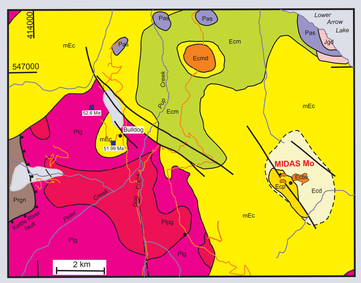
The Union mine produced 122,555 tonnes with 14.1 g/T Au and 353 g/T Ag, mainly in the 1930s. Precious and base metal mineralization is related to alkalic mafic intrusions, the Averill Complex.

Mineralization is variable, and includes skarn and a variety of veins. Controls include proximity to the Averill complex, and NNW-trending structures.

Recent Ar-Ar age dating confirms a middle Jurassic age for the Averill complex and mineralization.


Trenching on the IXL property (2004), photo courtesy of L. Caron.

Midas-Bulldog area



Eocene
- Coryell syenite; undifferentiated
- Em monzonite
- Ecm monzodiorite
- Eg syenite porphyry
- Ebx breccia complex
- Ed dike complex; alteration

Eocene/Paleocene
- Okanagan batholith
- megacrystic granite

Jurassic
- Jgd granodiorite / granite

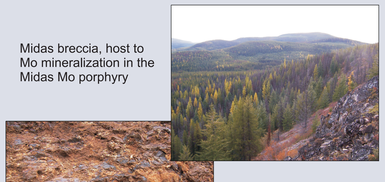
Paleozoic
- mEc metavolcanic rocks; metasediments

Proterozoic
- Grand Forks gneiss

- mineral deposit, occurrence
- U-Pb zircon date
- fault: defined, approximate
- geological contact: defined, approximate

Geology modified from Tempelman-Kluit (1989) and Hoy and Jackaman (2010)

Geology of the Midas Mo porphyry and gold vein mineralization at the Bulldog showing


Midas breccia, host to Mo mineralization in the Midas Mo porphyry

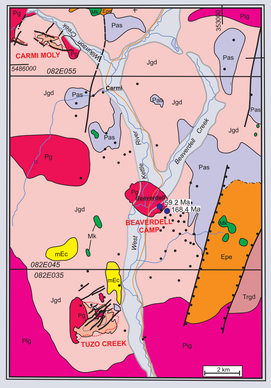

The Midas poprhyry is a small stock within the Eocene Coryell batholith.

Similarly, Bulldog mineralization occurs within and adjacent to a 52 Ma syenite stock that intrudes Paleogene Okanagan batholith

NNW trending structures control distrubution of these intrusions and host mineralization


Molybdenite veining in Eocene (ca. 52 Ma) porphyry

Beaverdell- Carmi-Tuzo Creek



Neogene
- Kallis formation

Eocene
- Ec Coryell syenite
- Em Penticton group

Paleocene
- Pg Okanagan batholith
- massive / porphyritic granite

Jurassic/Triassic
- Jgd J granodiorite / granite
- Trgd Tr granodiorite / granite

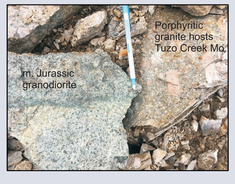
Paleozoic
- Paa metavolcanic rocks; metasediments

- mineral deposit, occurrence
- U-Pb; Ar-Ar date
- U-Pb sample locality
- unconformity
- fault; known, approximate
- contact
- dike swarm; alteration
- alteration zone
- intense alteration zone

Geology of the Beaverdell, Carmi and Tuzo Creek area; modified from Reinecke (1915), Massey et al. (1980) and Leary (1987)

View to the SSW, from a waste dump in the Beaverdell camp to the Tuzo Creek deposit

The Highland Bell mine in the Beaverdell camp produce 34.7 M oz. silver from 1896-1991, mainly from rich east-west trending Ag-Pb-Zn veins. Tuzo Creek and Carmi Mo have both been explored for porphyry Mo-(Cu) since their discovery in the 1960s.

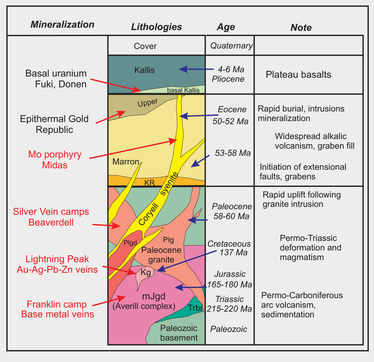


Spectacular wire silver, Highland Bell


Sphalerite, galena, ruby silver vein

Mineralization in the Beaverdell precious metal vein camp is related to a Paleocene granitic intrusion dated at 59.2 Ma (Ar-Ar). Porphyry style Mo mineralization at Tuzo Creek and Carmi Mo are also associated with similar small intrusions. These stocks all intrude middle Jurassic granodiorite.

Penticton east-half: lithologies, ages and mineralization



Metallogeny

Summary: Intrusive-related mineralization

Granitic and syenitic batholiths dominate the geology of the northern Boundary District in the Penticton east-half map area. These record repeated magmatic episodes in the Triassic and Jurassic, locally in the Cretaceous, and throughout the Paleocene and Eocene.

Numerous, commonly high-level stocks intrude or are late differentiates within these batholithic bodies, and these have the potential for hosting base- and precious-metal mineralization.

Examples include vein mineralization in the Jurassic Franklin camp, precious-metal veins in the Cretaceous Lightning Peak camp, vein and porphyry style mineralization in the Beaverdell area, and numerous examples of precious-metal veins and porphyry mineralization in Eocene granitic or syenitic rocks.

The distribution of these intrusions, and mineralization, is related to prominent structures, including early and reactivated northwest-trending structures and north-trending Paleogene extensional tectonics

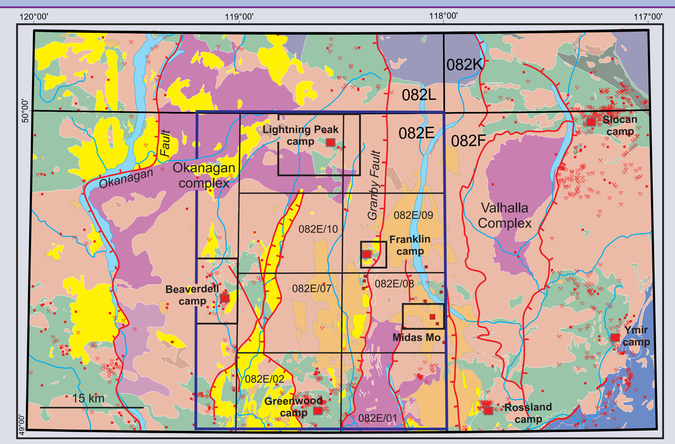
2019 Boundary District project

Project Summary

The project is a continuation of systematic 1:50:000 geological mapping and compilation of the east half of the Penticton map sheet (NTS 082E). The focus of the project has been to determine the ages and controls of the various types of deposits that occur throughout the map area and to provide updated regional base maps and deposit models that may enhance further exploration.

A large part of the Boundary area is underlain by poorly dated granitic and alkalic intrusive rocks that have been variously assigned to largely undifferentiated Jurassic “Nelson” Complex, Cretaceous granite, Paleogene “Okanagan” batholith or Eocene “Coryell” syenite.

The 2019 project was directed towards examining several examples of mineral deposits related to small stocks within these intrusive complexes, to determine their ages, and to highlight the potential for discovery of other small intrusions and associated mineralization within batholithic terranes.



- Eocene Coryell intrusions
- Tertiary Penticton Group
- Jurassic/Eocene intrusions
- Paleozoic successions
- Kootenay terrane
- Slide Mountain terrane
- Core complex
- Tertiary fault
- Mineral deposit camp
- Mineral showing
- Past producer

Terrane map showing mineral occurrences and locations of camp studies

2019 Boundary-Okanagan District samples

sample	UTM E	UTM N	rock type	formal unit	method	date	age	note
Beaverdell area (082E/06)								
AM19-577	349211	5477455	granite	Beaverdell granite	Ar-Ar Mu	59.2 Ma	Paleocene	hosts Beaverdell veins
AM19-579	349520	5477452	granodiorite	Nelson	Ar-Ar Hb	168.4 Ma	Jurassic	hosts Beaverdell veins
H19-118	342827	5487005	qtz monzonite	Carmi pluton			Paleocene (?)	analysis in progress
H19-149	344974	5482539	rhyolite	Marron			Eocene (?)	analysis in progress
Chenier (082E/06)								
H19-45	346501	5462996	granodiorite	Nelson	U-Pb Zr	163.7 Ma	Jurassic	hosts Chenier mineralization
Lightning Peak Area (082E/15)								
LP-109	387216	5532116	bi granodiorite	Lightning Peak stock	U-Pb Zr	137.33 Ma	Cretaceous	hosts Lightning Peak veins
LP-143	389688	5533746	bi granodiorite	Nelson	U-Pb Zr	164.07 Ma	Jurassic	
LP-227	379632	5522949	hb granodiorite	Nelson	U-Pb Zr	120-130?	Jurassic	hosts Lightning Peak veins
Deer Park; Midas deposit area (082E/08)								
H19-8	417248	5466999	monzonite	Coryell	U-Pb Zr	51.99 Ma	Eocene	
H19-10	416388	5468517	granite	Nelson	U-Pb Zr	52.6 Ma	Eocene	
H19-15	404434	5483958	granodiorite	Okanagan	U-Pb Zr	52.99 Ma	Eocene	
Franklin Camp (082E/09)								
BC-252	400651	5494199	monzonite	Averill Complex	Ar-Ar hb	161.3 Ma	M. Jurassic	hosts Franklin camp veining
BC-255	400355	5492907	monzodiorite	Averill Complex	Ar-Ar hb	176.0 Ma	E. Jurassic	hosts Franklin camp veining
BC-260	400452	5491927	syenite	Averill Complex	Ar-Ar hb	165.4 Ma	M. Jurassic	hosts Franklin camp veining
BC-262	399332	5493885	monzogabbro	Averill Complex	Ar-Ar bi	175.9 Ma	M. Jurassic	hosts Franklin camp veining

Note: All Ar-Ar dating by J. Gabites, U-Pb dating by R. Friedman (The University of B.C.) reference: Hoy, T., Friedman, R. and Gabites (2019 and in preparation).