Paleozoic to Eocene intrusions in the Golden Triangle, northwestern British Columbia: A project update

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Abstract

New fieldwork as part of an ongoing study to develop a plutonic framework for the Golden Triangle included examining rocks of the Texas Creek plutonic suite (Early Jurassic) in the Bronson corridor near Iskut River and in the Salmon Glacier area. The areally extensive Texas Creek batholith, Summit Lake stock, and Iskut River/Bronson stocks (ca. 197-193 Ma) range in composition from hornblende granodiorite to quartz monzonite and are coeval with distinctive K-feldspar porphyritic to megacrystic marginal phases, stocks, dikes, and related flows including the Red Bluff stock, Premier porphyry, and intrusions in the Kyber pass area. Several Au-rich (±Ag) mineral systems are on the periphery of the areally extensive granodiorite-quartz monzonite intrusions including the Scottie gold camp. K-feldspar porphyritic to megacrystic phases are spatially associated with, and locally host, porphyry Au-Cu mineralization including intrusions genetically related to the Bronson slope deposit.

Keywords: Plutonic rocks, Stikinia, Golden Triangle, porphyry Cu-Au-Mo, Jurassic, Texas Creek plutonic suite, Snip North, Bronson Slope, Scottie Gold, Red Bluff stock, Iskut River stock, Summit Lake stock, Texas Creek batholith

1. Introduction

This paper provides a progress update on an ongoing multi-year study of plutonic rocks in the 'Golden Triangle' of northwestern British Columbia, an area with numerous porphyry, epithermal, and VMS mineral deposits (Fig. 1; e.g., Nelson and van Straaten, 2020) on the traditional lands of the Tahltan Nation, Gitanyow Hereditary Chiefs, Metlakatla First Nation, Tsetsaut Skii Km Lax Ha, and Nisga'a Nation. The project is aimed at developing a framework for Paleozoic to Eocene intrusions in the region, which host numerous porphyry, epithermal, and VMS systems and is a companion to a project focused on developing a framework for Triassic-Jurassic supracrustal rocks (van Straaten, 2026). Through detailed field and drill core studies of areally extensive plutons and intrusions associated with significant mineralization, complemented by geochronological, petrographic, lithogeochemical, radiogenic isotope, physical property, and mineral chemistry analyses, the project will provide improved constraints on the magmatic and metallogenic evolution of the region. By providing a consistent characterization and framework for regionally significant intrusions, including known mineralizing phases, this project aims to assist mineral exploration companies in targeting prospective intrusions.

The project is in its second year. Preliminary results from the first year of fieldwork in the Telegraph Creek area (Fig. 2) are reported in Campbell and van Straaten (2025), complemented by geochronological studies reported in Bailey et al. (2025). In this paper, we provide an interim progress report on the project and provide examples from studies of the Texas Creek plutonic suite in the Bronson corridor and Salmon Glacier areas (Fig. 2).

2. Geological setting

The Golden Triangle is underlain by rocks of Stikine terrane (Stikinia), a Paleozoic to Mesozoic island arc terrane which, along with the Quesnel island arc terrane, hosts most of the porphyry deposits in the Canadian Cordillera (e.g., Logan and Mihalynuk, 2014). The stratigraphic architecture and plutonic framework of Stikinia was strongly influenced by a series of collisional processes that began during the Late Triassic and ended with the Middle Jurassic accretion of Stikinia and other Intermontane terranes to Ancestral North America (e.g., Mihalynuk et al., 2004; Nelson et al., 2013; Nelson and van Straaten, 2020).

The Late Triassic to Early Jurassic stratigraphy of the Golden Triangle includes Stuhini Group (Upper Triassic) mafic to intermediate volcanic, volcaniclastic and sedimentary rocks and lower Hazelton Group (uppermost Triassic-Lower Jurassic) intermediate, lesser felsic and mafic volcanic, volcaniclastic, and sedimentary rocks (Fig. 3; e.g., Nelson et al., 2018, 2022). The Texas Creek plutonic suite (ca. 204-185 Ma, latest Triassic-Early Jurassic) is comagmatic and coeval with lower Hazelton Group volcanic rocks (Kaip, 1997; Lewis et al., 2001; Nelson et al., 2018, 2022; Febbo et al., 2019; Campbell, 2021), and genetically related to most porphyry Cu-Au and epithermal Au-Ag deposits in the region (e.g., Britton et al., 1989; Alldrick, 1993; Kyba and Nelson, 2015; Nelson and van Straaten, 2020). The Texas Creek plutonic suite includes small volume, hypabyssal diorite to monzonite to quartz monzonite intrusions (ca. 204-185 Ma; Febbo, 2016; Febbo et al., 2019; Campbell, 2021) that are in many cases genetically linked to porphyry and epithermal

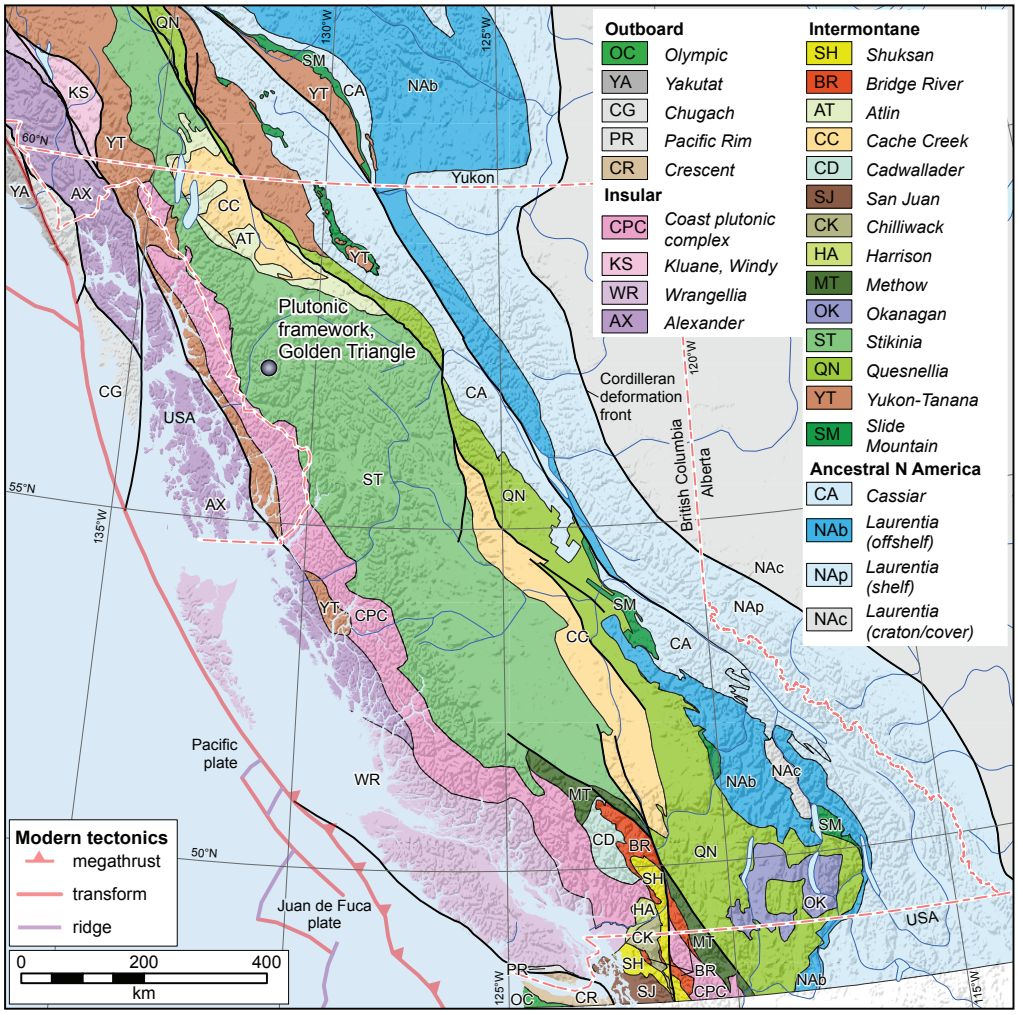

Fig. 1. Location of the Golden Triangle plutonic framework project. Terranes after Colpron (2020).

deposits. The suite also includes a series of areally extensive granodiorite to quartz monzonite plutons (ca. 195-193 Ma; Alldrick, 1993; Lewis et al., 2001; Evenchick et al., 2004; Miller et al., 2025a, b) that outcrop from Kitsault to the lower Iskut River (e.g., Bulldog Creek pluton, Texas Creek batholith, Summit Lake stock, and Lehto pluton; Fig. 2).

3. Fieldwork carried out to date

In 2024, we carried out eight weeks of fieldwork in the northern portion of the Golden Triangle (Fig. 2). Preliminary results on Late Triassic to Early Jurassic intrusions are reported in Campbell and van Straaten (2025), and additional fieldwork focused on the Forrest Kerr and More Creek plutonic suites (Late Devonian-Mississippian), Gnat Lakes plutonic suite (Late Triassic), Three Sisters plutonic suite (Middle Jurassic), and younger intrusions. In 2024, we also carried out one week of field studies in the southwestern portion of the Golden Triangle including the Texas Creek and Melville plutonic suites (Early Jurassic), and Hyder and Alice Arm plutonic suites (Eocene; Fig. 2).

In 2025, we carried out eight weeks of fieldwork between Galore Creek and Stewart (Fig. 2). At each location, we studied areally extensive plutons and intrusions associated with mineralization and took samples for further analytical studies. To date we have submitted 671 samples for lithogeochemistry and 57 samples for geochronology.

4. Bronson corridor and Salmon Glacier

Below we present observations from two of our ten 2025 field sites, the Bronson corridor and Salmon Glacier area (Fig. 2).

4.1. Bronson corridor

The Bronson corridor (Metcalfe and Moors, 1993) is a belt of mineral occurrences between the Iskut-Verrett and Sky faults (Fig. 4), which includes (from northwest to southeast): the Snip North porphyry Cu-Au occurrence (Adam, 2023; MINFILE 104B 312); the past-producing Snip and Johnny Mountain gold veins (Rhys, 1993; MINFILE 104B 250, 107); the Bronson Slope porphyry Cu-Au deposit (Rhys, 1995; MINFILE 104B 077); the Khyber Pass,

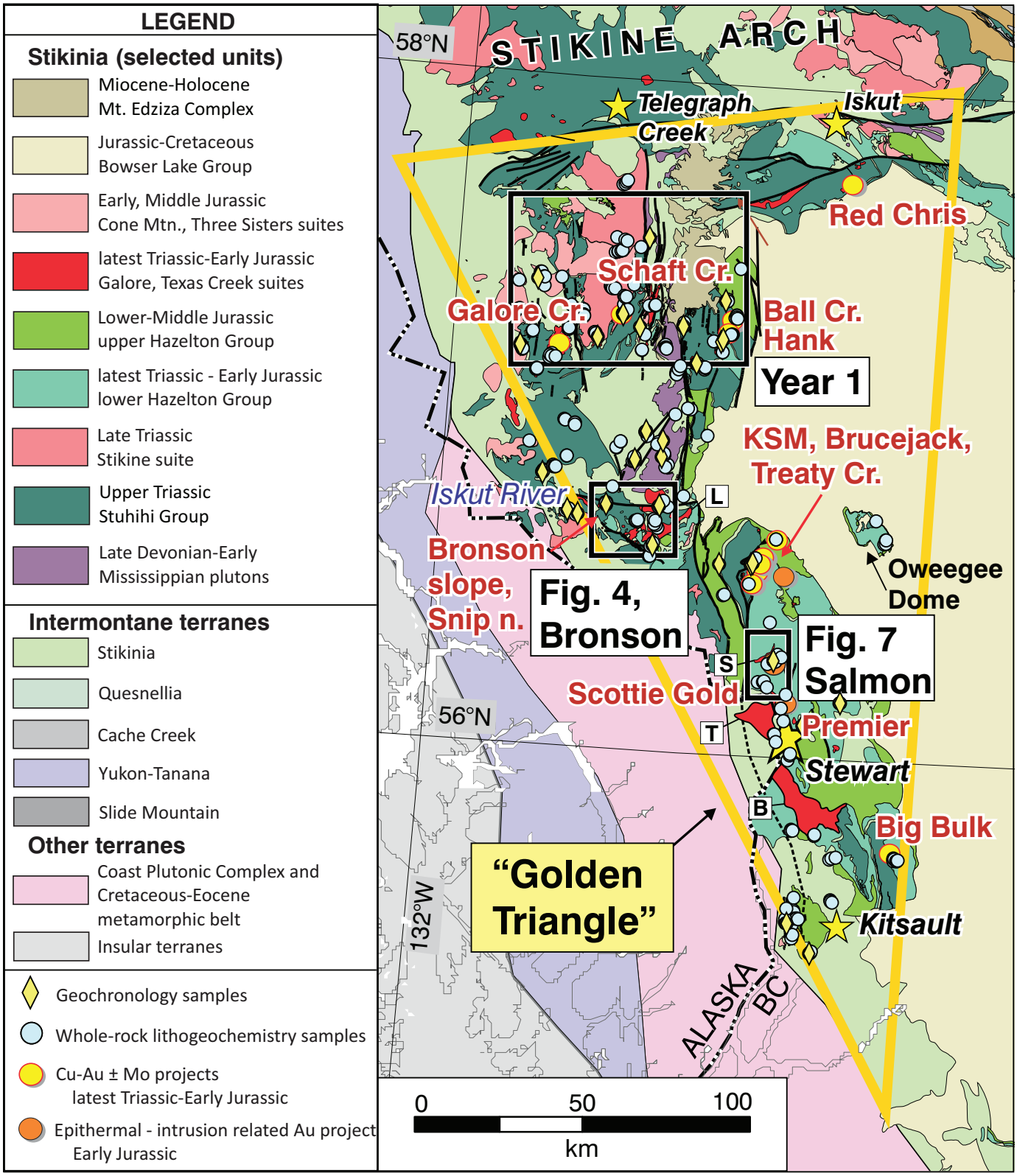

Fig. 2. Late Triassic to Middle Jurassic stratigraphy, plutonic suites, and structural setting of northwestern British Columbia. The Golden Triangle hosts numerous porphyry, epithermal, and volcanogenic massive sulphide deposits. Year 1 refers to work in Campbell and van Straaten (2025); insets for geology of the Bronson corridor (Figure 4) and Salmon Glacier (Figure 7) areas. Abbreviations: L – Lehto pluton, I – Inel stock, S – Summit Lake stock, T – Texas Creek batholith, and B – Bulldog Creek pluton. Geochronology and whole-rock lithogeochemistry samples include all samples submitted following the 2024 and 2025 field seasons. After Nelson and van Straaten (2020).

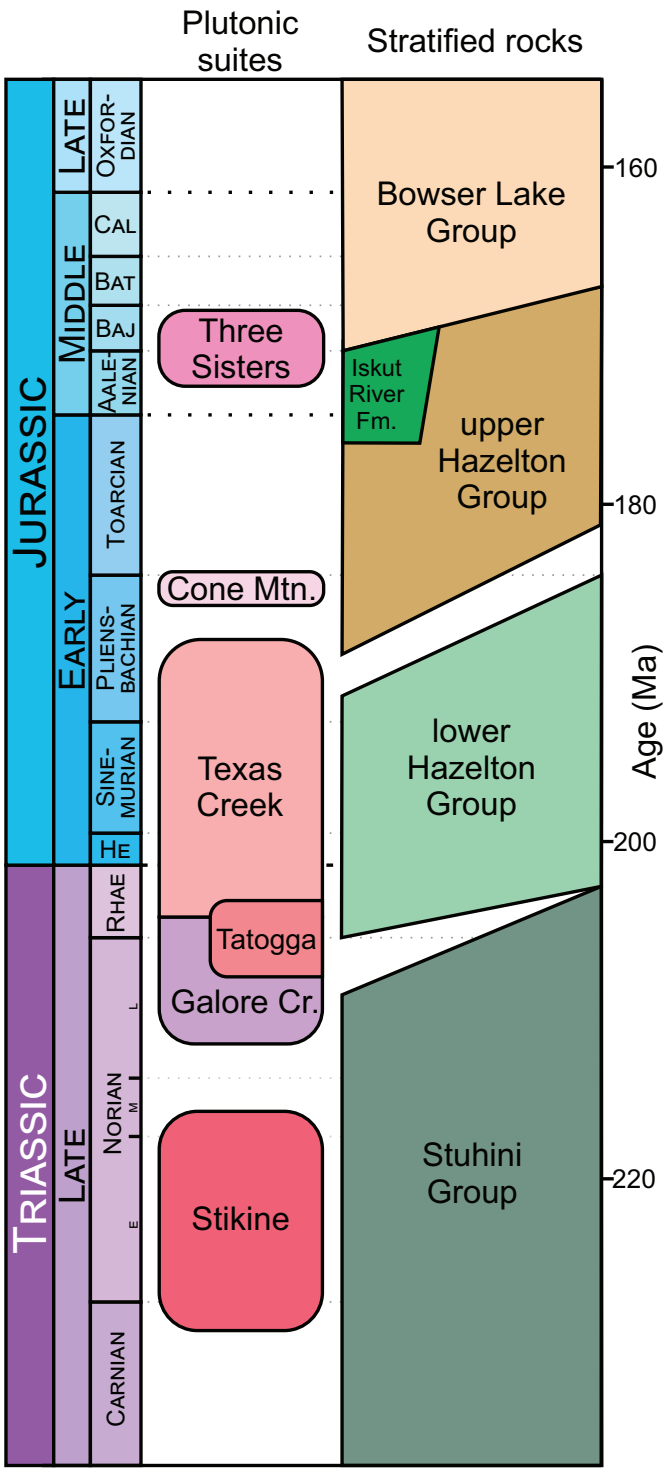

Fig. 3. Schematic Triassic-Jurassic stratigraphic and intrusive framework of the Golden Triangle. Geological timescale after Cohen et al. (2025).

Inel, and Camp porphyry occurrences (MINFILE 104B 113, 138, 697); broad sericite-quartz-pyrite alteration at Sericite Ridge (MINFILE 104B 116); and the Pins and Pins Bowl occurrences (MINFILE 104B 111, 115, 636). Many of these mineral occurrences are spatially associated with, and locally hosted by, Early Jurassic plutons, stocks, and dikes that we assign to the Texas Creek plutonic suite, and include (from northwest to southeast) the Iskut River/Bronson stock (9 km^2); Red Bluff stock (0.75 km^2); the Inel stock (3 km^2; Lefebure and Gunning, 1989; Britton et al., 1990; Rhys and Lewis, 1993; Rhys et al., 1995; Lewis, 2013; Oliver, 2018); small intrusions in the Kyber pass area (0.1 km^2; Kyba and Nelson, 2015; Oliver, 2018; Nelson and van Straaten, 2020); and the areally extensive Lehto pluton (at least 83 km^2; Britton et al., 1989; Lewis, 2013; Kyba and Nelson, 2015; Oliver, 2018). Based on 2025 fieldwork, we distinguish two Texas Creek plutonic suite (Early Jurassic) units in the northwestern and central parts of the Bronson corridor (Fig. 4), one a hornblende quartz monzodiorite unit (EJTdqmd) the other a K-feldspar megacrystic quartz monzonite unit (EJTdqm.tm).

4.1.1. Hornblende quartz monzodiorite unit (EJTdqmd)

The Iskut River/Bronson stock outcrops on either side of the Iskut River (Fig. 4). The poorly exposed southeastern portion of the stock consists of an equigranular to weakly K-feldspar porphyritic, hornblende quartz monzodiorite to monzodiorite (Fig. 5a; Table 1).

4.1.2. K-feldspar megacrystic quartz monzonite unit (EJTdqmz.tm)

A K-feldspar porphyritic to megacrystic, biotite-bearing to hornblende-bearing quartz monzonite unit is exposed in the northwestern and western parts of the Iskut River/Bronson stock, in the Red Bluff stock, and at the Khyber Pass occurrence (Fig. 4; Table 1). Relative to the hornblende quartz monzodiorite unit (EJTdqmd), the rocks are more feldspar porphyritic, with large (>10-45 mm) K-feldspar phenocrysts, have no or minor hornblende, and an aphanitic to fine-grained groundmass. At Snip North, drilling intersected quartz monzonite to monzonite, interpreted as the western margin of the Iskut River/Bronson stock, and related m-scale dikes hosted by Stuhini Group sedimentary rocks (Fig. 5b; Adam, 2023). This is broadly consistent with previous descriptions by Lefebure and Gunning (1989), Britton et al. (1990) and Mihalynuk et al. (2011). The Red Bluff stock is a tabular body consisting of hornblende-bearing(?) K-feldspar porphyritic monzonite to quartz monzonite(?). The stock is comparable to quartz monzodiorite to quartz diorite compositions reported by Rhys (1995) and a pre-mineral monzonite stock cut by early- to syn-mineral quartz monzonite dikes and a late-mineral quartz monzonite plug reported by Nevarez (2025).

4.1.3. Relationship of intrusions and mineralization

Gold and copper mineralization at Bronson slope is in quartz-magnetite (±chalcopyrite, pyrite) veins and breccia zones partially hosted by the margin of the potassically altered Red Bluff stock (Rhys, 1995; Adam, 2023; Nevarez, 2025). At the Khyber Pass occurrence, drilling intersected m- to 10s of m-wide hornblende-bearing quartz monzonite to monzonite dikes, similar to monzonite intrusions identified in surface

Table 1. Lithology of major intrusions in the western and central portions of the Bronson corridor and the Salmon Glacier area. Abbreviations: d = diorite, gd = granodiorite, qmd = quartz monzodiorite, md = monzodiorite, qmz = quartz monzonite, mz = monzonite, eq = equigranular, wpo = weakly porphyritic (1-20% porphyritic phenocrysts), po =porphyritic (20-50% porphyritic phenocrysts), cpo = crowded porphyritic (>50% phenocrysts), mx = megacrystic (phenocrysts >20 mm), aph = aphanitic (not visible with the naked eye), f = fine grained (<1 mm), m = medium grained (1-5 mm), c = coarse grained (5- 30 mm), vc = very coarse grained (>30 mm), Kfs = K-feldspar, Pl = plagioclase, Fsp = feldspar, Hbl = hornblende, and Bt = biotite. Source: [1] Brown (1987), [2] Alldrick (1993), [3] Macdonald et al. (1992), [4] Lewis et al. (2001), [5] A. Zagorevski (pers. comm., 2026).

Unit	Name	Composition	Texture	Kfs and mafic mineral abundance and size	Groundmass grain size	U-Pb zircon age (Ma)
EJT dqmd	Bronson/Iskut River stock (SE)	qmd-md	eq-wpo	15-20% Kfs (2-8 mm incl. sparse 1-2% 15-20 mm), 10-20% Hbl (1-8 mm)	f-c	
EJTdqmz.tm	Bronson/Iskut River stock (W, NW)	qmz-mz(?)	po-cpo-mx	5-15% Kfs (10-45+ mm), <25-40% Fsp (Pl>Kfs; 1-4 mm), <3% Bt(?) (<1 mm)	aph-f	195.98 ±0.79[5], 193.9 +6.0/-0.6[4]
	Red Bluff stock	qmz-mz(?)	po-mx	0.5-15% Kfs (2-20+ mm), <5-8% Hbl(?)	aph-f	195 ±1[3]
	Khyber pass	qmz-mz(?)	po-mx	5-10% Kfs (5-20 mm), 0-5% Hbl (1-3 mm)	aph-f	
EJTgd	Texas Creek batholith 'main phase'	gd, gd-qmd	eq-wpo	5-10% Kfs (3-5 mm incl. 0-2% 10-15 mm), 10-20% Hbl (3-15 mm), 0-5% Bt (2-3 mm)	m, m-c	
	Summit Lake stock	gd-qmd	eq-wpo	5-10% Kfs (2-6 mm incl. 0-2% >10 mm), 15-20% Hbl (4-20 mm), 5-8% Bt (2-4 mm)	m-c	192.8 ±2[2]
EJT gd.tm	Texas Creek batholith 'porphyry phase'	gd-qmd(?)	po-mx	10-15% Kfs (3-33 mm), 8-20% Hbl (3-10 mm)	f, aph-f	195 ±2[2]
	Premier porphyry dikes[1, 2]	gd-d(?)	po-mx	<0.1-10% Kfs (<10-50 mm), 2-8% Hbl (<10 mm)	aph-f	194.8 ±2[2]

mapping by Oliver (2018). In the Khyber Pass and Snip North areas, Au-Cu mineralization is hosted by quartz-sericite-pyrite and biotite ±magnetite-K-feldspar altered Stuhini Group rocks rather than intrusive rocks (Oliver, 2018; Adam, 2023; Nevarez, 2025). At both Khyber Pass and Snip North, intrusive rocks are locally hydrothermally altered and veined. Available geochronological data indicates that intrusions are broadly contemporaneous with mineralization. A Re-Os molybdenite age of 196.5 ±0.8 Ma (Dawson, 2015, 2016) was obtained from a silica-sericite-pyrite altered and quartz veined granodiorite intrusion adjacent to weakly Cu-Au mineralized Stuhini Group sedimentary rocks (drill hole KSP14-002, 490 metres west of the Khyber Pass occurrence; Fig. 4).

Within the Bronson corridor, overlapping 197.4 ±1.0, 196.5 ±1.0, and 196.5 ±0.8 Ma Re-Os ages were obtained from the Red Bluff porphyry by Nevarez (2025) and the Kyber Pass occurrence by Dawson (2015, 2016; Fig. 6). These ages of mineralization overlap within error a 195.98 ±0.79 Ma U-Pb zircon age from the Iskut River/Bronson stock (A. Zagorevski, pers. comm., 2026), and a 193.9 +6.0/-0.6 Ma U-Pb zircon age obtained from the Iskut River stock (Lewis et al., 2001), although a location, lithology description, and analytical data have not been reported for the latter. A 195 ±1 Ma U-Pb zircon minimum age was reported from the Red Bluff stock (Macdonald et al., 1992; Fig. 6). The apparent 195 ±1 Ma U-Pb age is affected by lead loss and may be too young, based on new Re-Os molybdenite ages of mineralization cutting the pre-mineral stock (Nevarez, 2025). Further high-precision geochronological work is required to determine exact temporal relationships between local intrusive phases and metallogenetic events.

4.2. Salmon Glacier area

The Salmon Glacier area includes the past-producing Scottie gold mine and the Blueberry gold deposit (Fig. 7; MINFILE 104B 034, 133; Bird, 2025). Gold mineralization is generally described as intrusion-related shear vein-hosted, generally within 1 km of the southeastern to southern margin of the Summit Lake stock. We studied the 205 km^2 Texas Creek batholith and the 13 km^2 elongate northeast

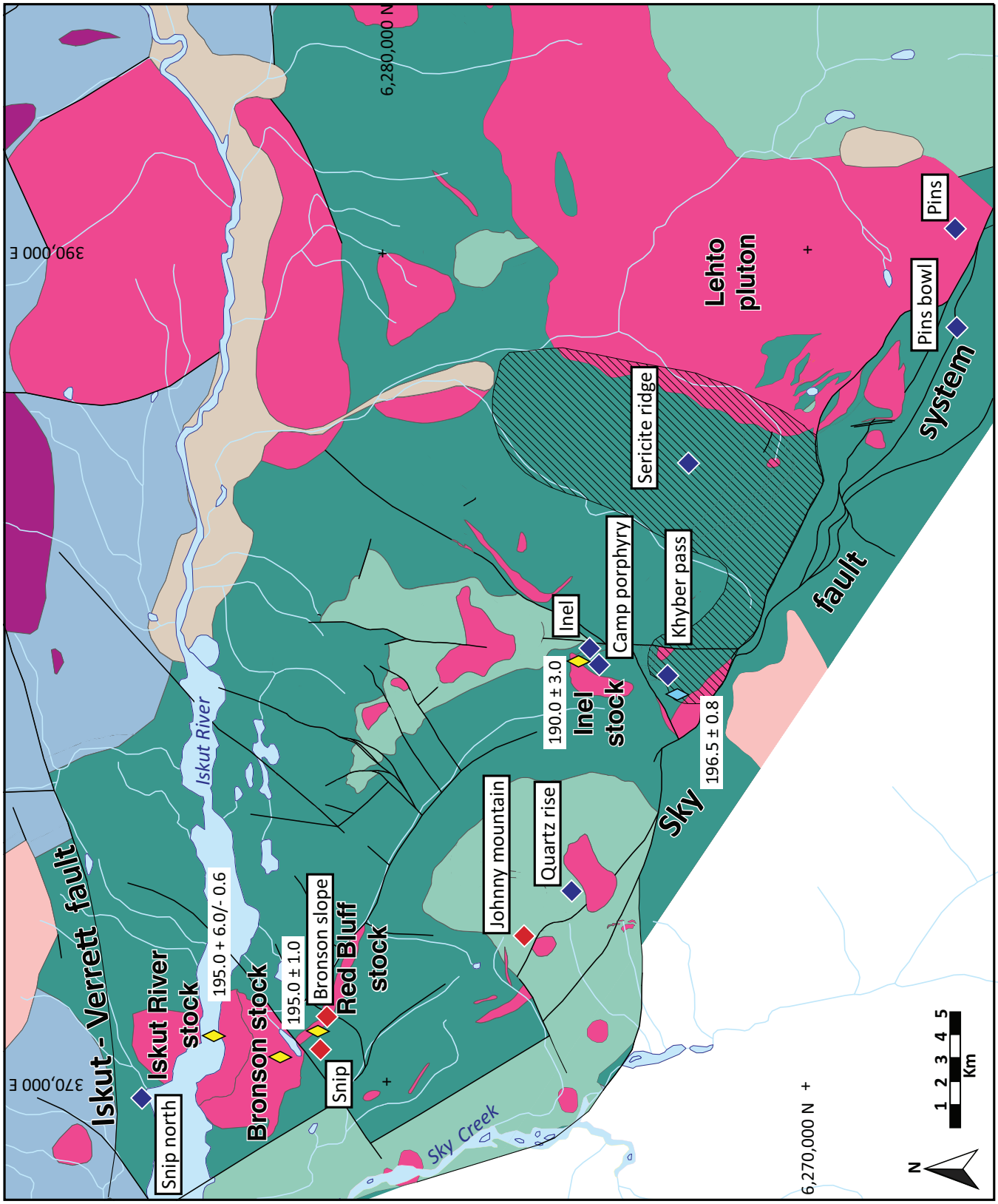

Fig. 4. a) Geology of the Bronson corridor after Lewis (2013), Kyba and Nelson (2015), and British Columbia Geological Survey (2019). UTM Zone 9 north, NAD 83. **b)** Legend.

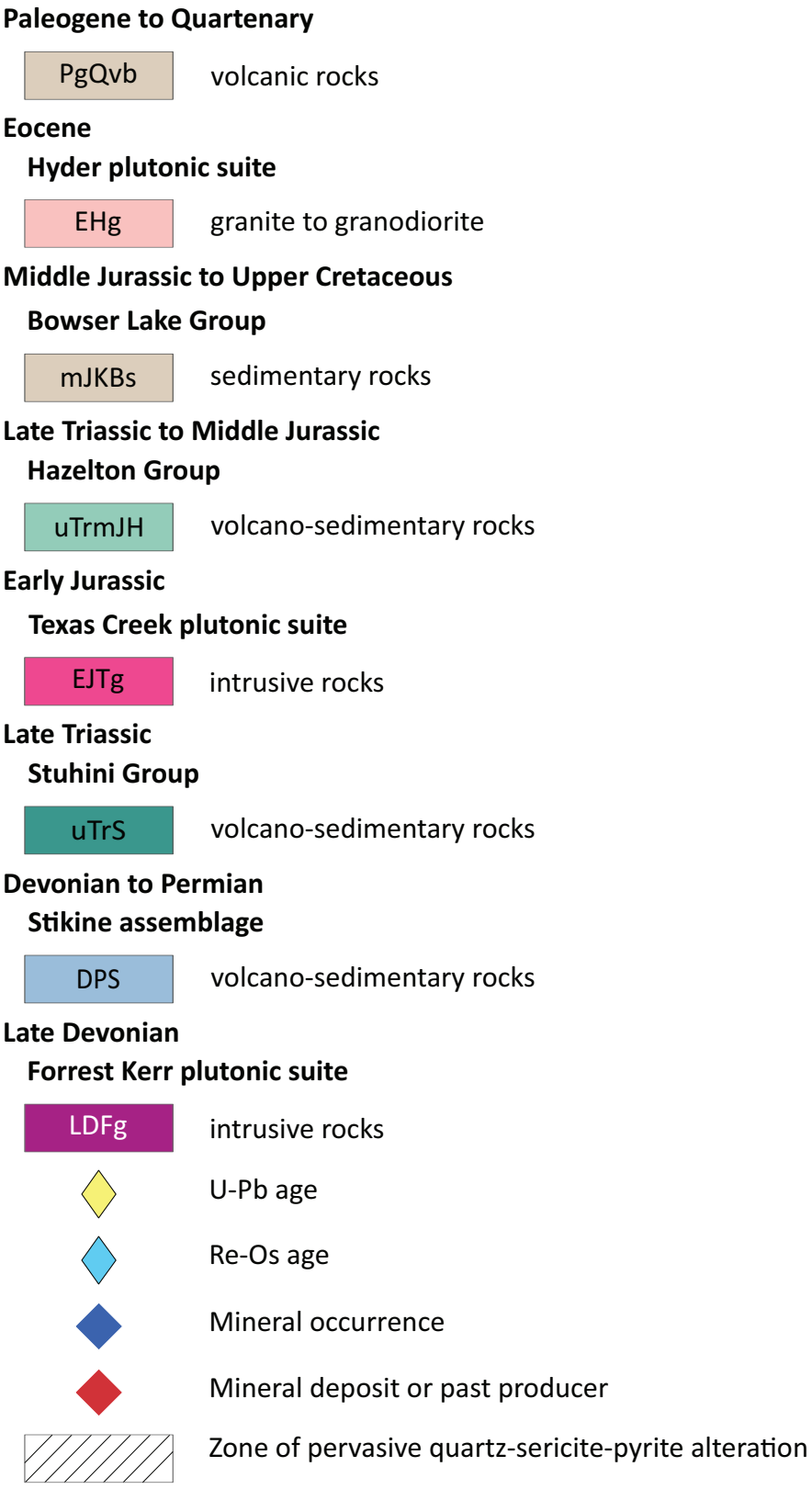

Fig. 4. b) Legend.

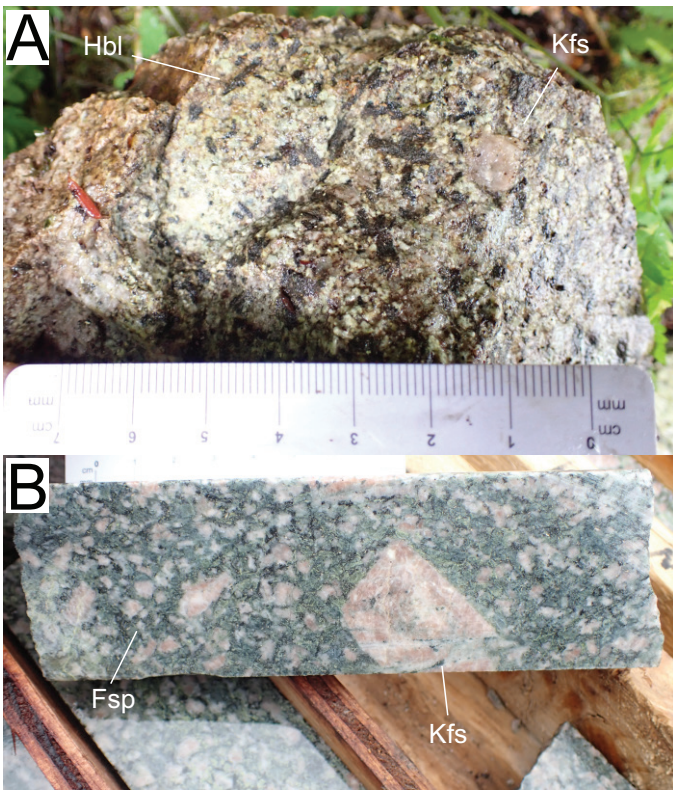

Fig. 5. Texas Creek plutonic suite intrusions from the Bronson corridor. **a)** Medium-grained, weakly K-feldspar porphyritic, hornblende quartz monzodiorite (unit EJTdmzd) from the southeastern Iskut River/Bronson stock. 56.686218°N, 131.086597°W. **b)** Porphyritic to K-feldspar megacrystic quartz monzonite to monzonite(?) (unit EJTdqmz.tm) with 5 to 25% salmon pink, zoned K-feldspar (10-40+ mm), and 20% feldspar (1-4 mm) from the Snip north project (northwestern Iskut River/Bronson stock). Drill hole SN-24-22 collared at 56.691331°N, 131.128932°W.

trending Summit Lake stock (Alldrick, 1993), both part of the Texas Creek plutonic suite (Fig. 7), distinguishing a hornblende granodiorite unit (EJTgd) and a K-feldspar megacrystic hornblende granodiorite unit (EJTgd.tm).

4.2.1. Hornblende granodiorite unit (EJTgd)

The hornblende granodiorite unit is the main phase of the Texas Creek batholith, and the sole phase of the Summit Lake stock. We observed the Texas Creek batholith along the Granduc mine road (Alaska) as a weakly K-feldspar porphyritic hornblende granodiorite. Northwest and northeast of Mount Lindeborg, close to the northern contact of the Texas Creek batholith, it consists of an equigranular biotite-bearing hornblende granodiorite to quartz monzodiorite. Our observations corroborate descriptions of the 'main phase' of the batholith by Alldrick (1993). The Summit Lake stock consists of biotite hornblende granodiorite to quartz monzodiorite with a slightly higher biotite abundance than the northern Texas Creek batholith (Fig. 8a), consistent with the description of Alldrick (1993). The core of the Summit Lake stock is weakly K-feldspar porphyritic.

4.2.2. K-feldspar megacrystic hornblende granodiorite (EJTgd.tm)

Near the northern margin of the Texas Creek batholith, is an estimated 600 m-wide, weakly K-feldspar megacrystic hornblende granodiorite to quartz monzodiorite (Fig. 8b). Alldrick (1993) mapped a comparable 'porphyry phase' (up to several 100 m wide) along the eastern margin of the Texas Creek batholith. The 'porphyry phase' cuts the 'main phase' hornblende granodiorite, and Alldrick (1993) considered the 'porphyry phase' to be texturally and compositionally similar to a series of K-feldspar megacrystic to porphyritic dikes and coeval flows in the lower Hazelton Group (termed 'Premier porphyry' in Brown, 1987).

4.2.3. Relationship to mineralization

U-Pb zircon geochronological data from the porphyry phase of the Texas Creek batholith (195.0 ±2.0 Ma; Alldrick, 1993) overlaps with K-feldspar porphyritic 'Premier porphyry' dikes collected near the Premier mine (194.8 ±2 Ma; Alldrick, 1993). Both ages are older than or overlap determinations from the Summit Lake stock (192.8 ±2.0 Ma U-Pb zircon; Alldrick, 1993). The ca. 193 Ma age for the Summit Lake stock is also supported by a 192.6 ±0.8 Ma Re-Os molybdenite age collected from a quartz-molybdenite veined, sericite altered, porphyritic granodiorite on the northern margin of the stock (van Straaten et al., 2014). An unpublished 192.55 ±1.0 Ma Re-Os molybdenite age from the Blueberry zone (T. Mumford, pers. comm., 2026) overlaps with the age of the Summit Lake stock and provides further indications that mineralization at Scottie Gold and Blueberry may be genetically related to the intrusion. Work is ongoing to better constrain the timing of these intrusive phases, and the Texas Creek plutonic suite more regionally, through high precision CA-TIMS geochronology.

5. Conclusion

New field studies in the central portion of the Golden Triangle region, from Galore Creek south to Stewart include a subset of field observations from the Texas Creek plutonic suite in the Bronson corridor and Salmon Glacier areas. In both areas, Early Jurassic Au-Cu and Au-Ag mineralization is in Stuhini Group and/or lower Hazelton Group rocks at the periphery of areally extensive Texas Creek plutonic suite hornblende granodiorite to quartz monzodiorite plutons and stocks (including the Scottie gold mine and the Summit Lake stock), or associated with and locally hosted by a distinctive suite of coeval K-feldspar porphyritic to megacrystic intrusions (including the Bronson slope porphyry deposit partially hosted by the Red Bluff stock). Existing Re-Os dates indicate the episodic nature of mineralization in the Bronson corridor to Salmon Glacier areas. Further analytical work will seek to better distinguish the age and character of these intrusions through high-precision geochronologic, lithogeochemical, isotopic, and mineral chemistry studies.

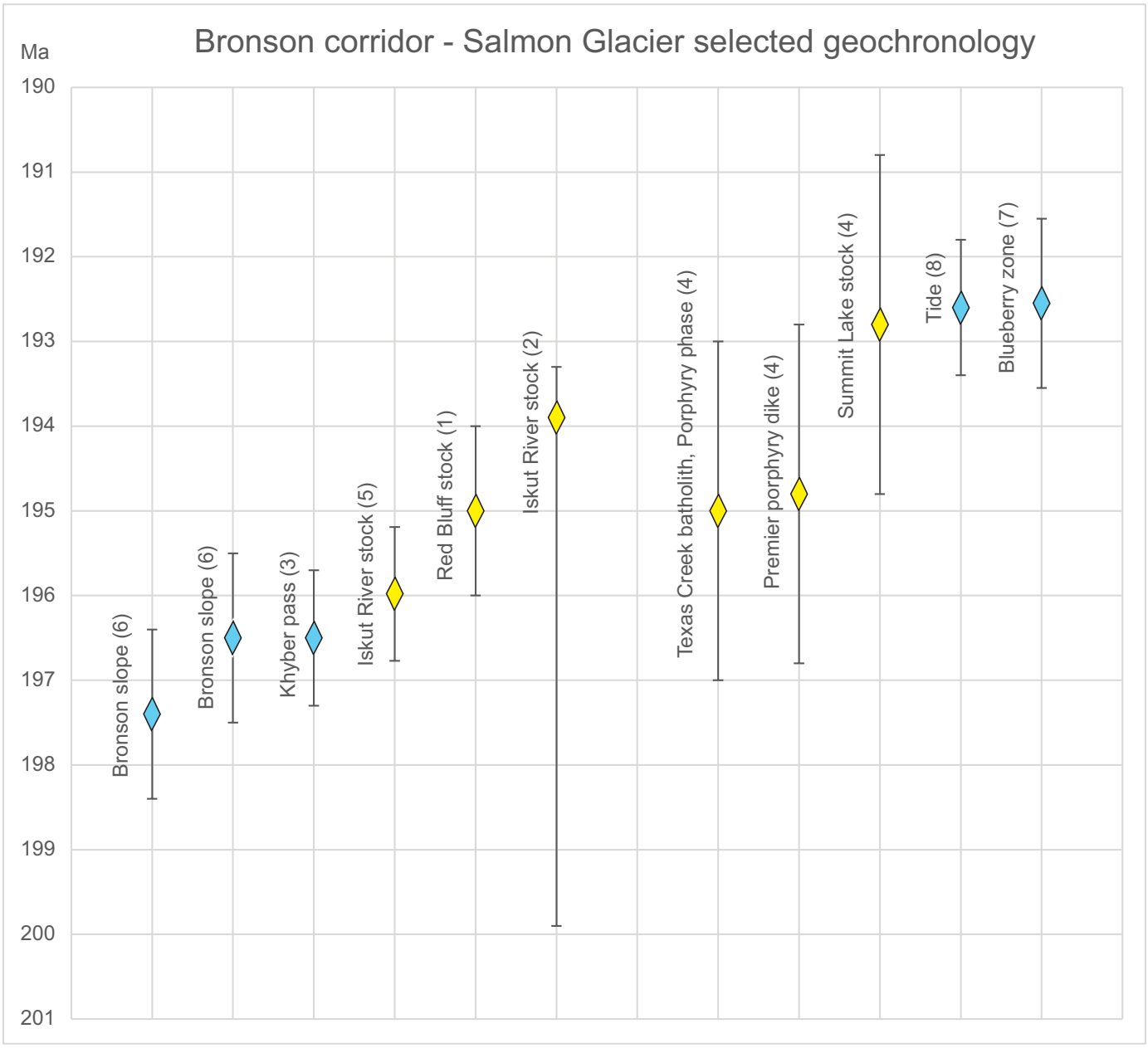

Fig. 6. Selected geochronological data from Bronson corridor and Salmon Glacier area. Ages from [1] Macdonald et al. (1992), [2] Lewis, et al. (2001), [3] Dawson (2015), [4] Alldrick (1993), [5] A. Zagorevski (pers. comm., 2026), [6] Yagual Nevarez (2025), [7] T. Mumford (pers. comm., 2026), and [8] van Straaten et al. (2014). Yellow diamonds indicate Re-Os from molybdenite and blue diamonds indicate U-Pb from zircon.

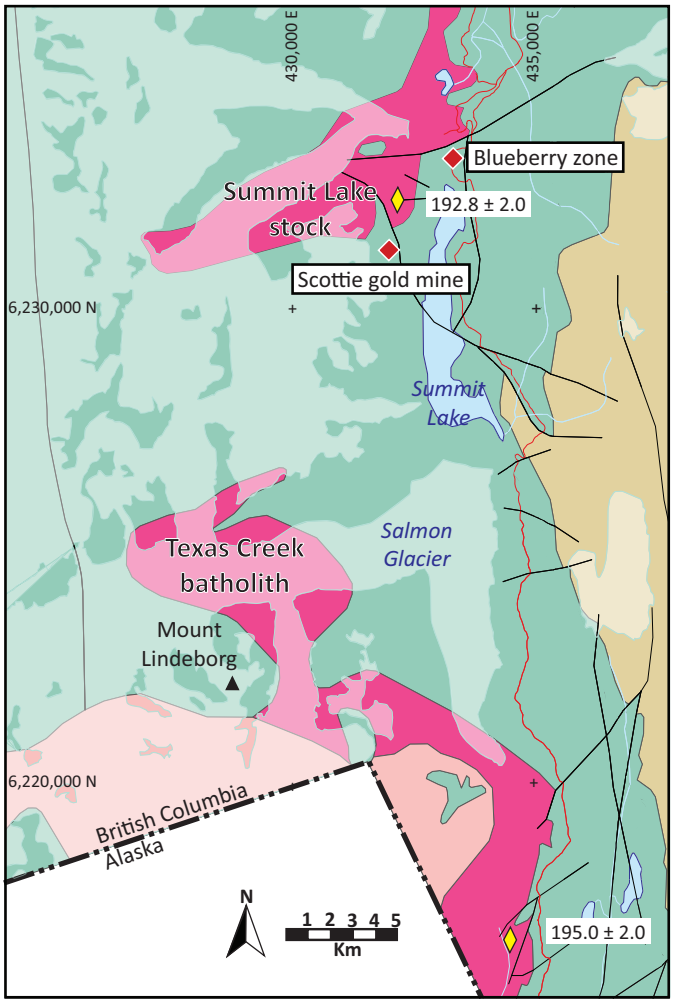

Fig. 7. Geology of the Salmon Glacier area after Alldrick (1993) and British Columbia Geological Survey (2019).

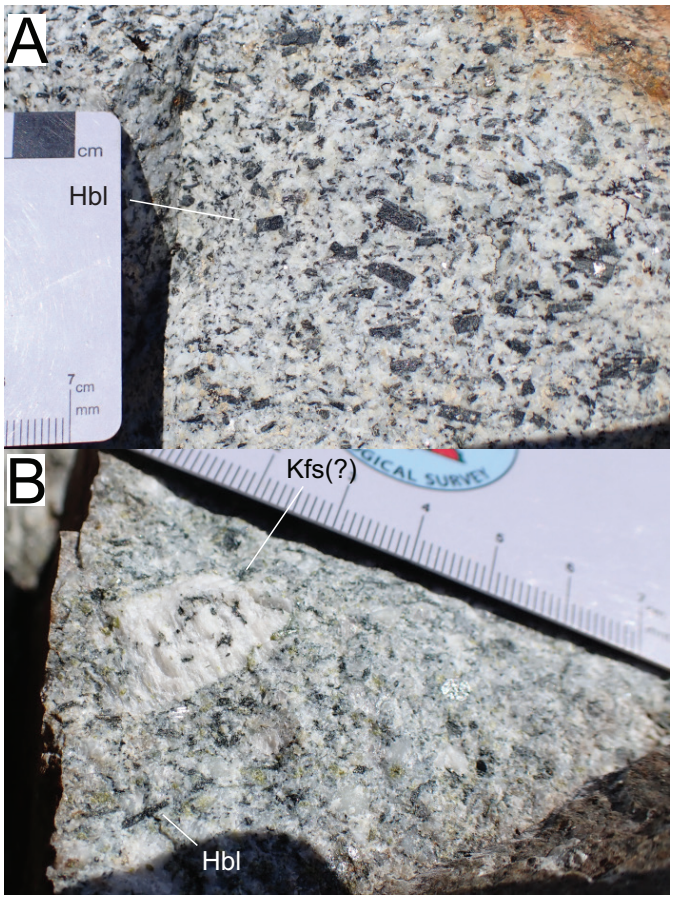

Fig. 8. Texas Creek plutonic suite intrusions from the Salmon Glacier area. **a)** Medium-grained, equigranular to weakly hornblende porphyritic, biotite-bearing hornblende granodiorite (unit EJTgd) from the Summit Lake stock. 56.231810°N, 130.098072°W. **b)** Medium-grained, K-feldspar megacrystic hornblende granodiorite (unit EJTgd. tm) from north of Mount Lindeborg. 56.169897°N, 130.151777°W.

Acknowledgments

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