Geology and Mineralization of the Iron Mask Batholith

Jim Logan, Mitch Mihalynuk, Tom Ullrich and Richard Friedman

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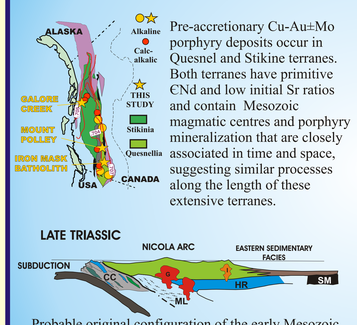
BC Alkaline Deposits

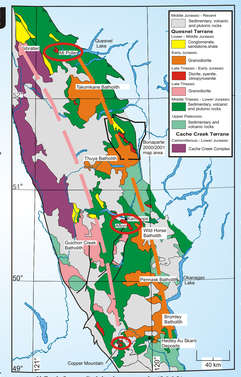
- Formed over narrow time interval – 200Ma
- From silica deficient vs alkali-enriched magmas
- At shallow depths – Pervasive vs fracture control alteration and mineralization
- Potassic, Calc-potassic and Sodic assemblages
- Metal assemblage Cu-Au-Ag, trace Mo
- Deposits comprise multiple structurally controlled centers rarely exceeding 150 Mt

Tectonic / Regional Setting



Pre-accretionary Cu-Au±Mo porphyry deposits occur in Quesnel and Stikine terranes. Both terranes have primitive εNd and low initial Sr ratios and contain Mesozoic magmatic centres and porphyry mineralization that are closely associated in time and space, suggesting similar processes along the length of these extensive terranes.

Probable original configuration of the early Mesozoic Quesnellian arc. CC= Cache Creek, ML= Mount Lytton, HR=Harper Ranch, SM=Slide Mountain, G=Guichon, I= Iron Mask batholiths (cartoon from Price and Monger, 2003).

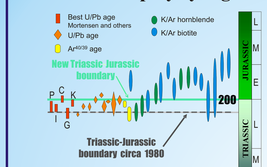


modified from Schiarizza et al. (2002)

Late Triassic Guichon Creek and Gibraltar plutons define an older western-most 212 Ma calcalkaline magmatic arc.
Successively younger arc segments formed as the magmatic front migrated eastward, including 200 Ma (alkaline) and 195 Ma (calcalkaline) episodes.
Cu-Au mineralization at Mount Polley, Iron Mask batholith and Copper Mountain is associated with alkaline centres. Porphyry Cu-Au±Mo mineralization at Gibraltar and Highland Valley is associated with the calcalkaline arc.

3-Stage Arc Development

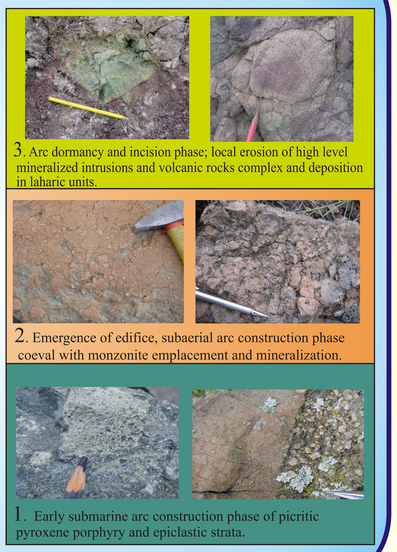
Cu-Au Porphyry Ages

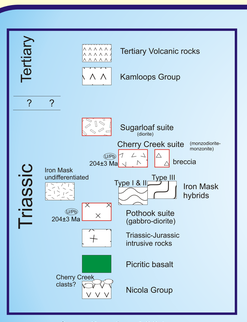


The plutons and enclosing arc strata are latest Triassic in age and were emplaced over a relatively short time interval from 210 to 200 Ma at the Triassic-Jurassic boundary. P=Polley, I=Iron Mask, C=Copper Mtn, G=Galore, K=Kemess.

Stratigraphic Relationships

- Picrite is a porphyritic basalt with olivine greater than pyroxene. Within the study area it is a breccia that can be traced as a stratigraphic unit. We were unable to conclusively demonstrate that the picrite is intrusive at any locality, however, intrusive feeders to the picritic basalts are expected.
- Clasts of Cherry Creek plagioclase porphyries in weakly mineralized Nicola tuffs located north of the Afton tailings pond indicate eruption and deposition prior to the end of the alteration and mineralization event at Afton.





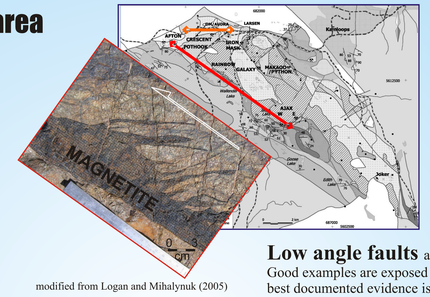
from Snyder, 1994

Plutonic Rocks

Pothook Pyroxene-biotite diorite | Hybrid Pyroxene-amphibole diorite | Cherry Creek Plagioclase porphyry monzonite trachytic fabric | Sugarloaf Hornblende porphyritic diorite

Structures in the Iron Mask area

Northwest trending high- and moderate-angle **faults** dominate the structural setting of the Iron Mask intrusive complex. Campbell and Tipper (1970) and Preto (1977) considered these to be major deep seated structures that were active as early as the mid-Triassic and as such, controlled deposition of the volcanic and sedimentary rocks of the Nicola Group as well as the intrusion of various phases of the Iron Mask batholith.

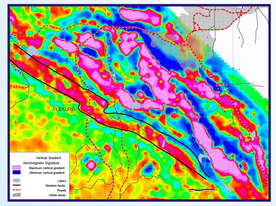


modified from Logan and Mihalynuk (2005)

Magnetite-apatite veins occupy southeast and easterly trends in the northwestern end of the batholith. They cut the Pothook and Cherry Creek phases in the Afton pit. East-trending **dilatent veins** at the Magnet mine are compatible with a northwesterly oriented sinistral shear. Southeast and easterly trending structural corridors of Cu-Au mineralization have long been known.

Schistosity

For the most part, rocks in the study area are not penetratively deformed. Exceptions occur 2km south of Jacko Lake, where Nicola volcanic rocks display an abrupt change from non-foliated to strongly schitose rocks. This fabric can be traced at least 12km northwest to the Afton tailings pond.
S_1 displays relatively steep northeast dips suggesting a strain field orientation like that which produced the southwest verging folds at Jacko Lake.
S_1 is locally folded by southeast-verging chevron folds with development of a second axial planar crenulation cleavage (S_2) that dips moderately northwest.



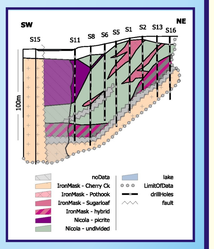
Vertical gradient aeromagnetic map.

Folded schistosity Cherry Creek Fault zone.

The **Cherry Creek Fault zone** marks an abrupt transition from non-foliated to strongly foliated rocks and corresponds with an equally abrupt drop in the aeromagnetic response of the well-exposed rocks. This is presumably due to magnetite destruction during fabric development. A strong vertical gradient results, which roughly corresponds with the mapped trace of the fault. Flexures within the trend of the vertical gradient anomaly (4km due west of Jacko Lake), might be due to a folded deformation front.

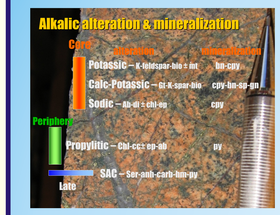
Low angle faults are sporadically observed in the batholith. Good examples are exposed in the Pothook and Ajax west pits, but, the best documented evidence is from Preto (1967) at the Galaxy deposit. Here at least 20 drill holes intersect a moderate to shallowly west-dipping mylonite zone that separates Nicola volcanic rocks, picrite and hybrid phase from fine-grained "albitized microdiorite" considered to be part of the Cherry Creek intrusive suite. According to Preto (1967), copper mineralization is focused both within the hangingwall volcanic rocks and in the mylonite zone. Structural juxtaposition of the mineralized and non-mineralized rocks, as well as development of copper mineralization within the mylonite zone, suggests that deformation and mineralization were at least partly synchronous.

Low angle west dipping fault, juxtaposes albitic gabbroic rocks with diorite. Insert shows offset epidote-calcite veins with apparent tops-to-the-southeast sense of motion.



Section 1100N from Galaxay Copper Ltd. Plan (Preto, 1967).

Mineralization and Alteration

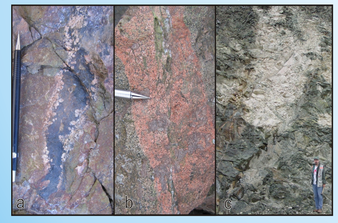


At least 10 copper-gold deposits are hosted by the Late Triassic polyphase Iron Mask batholith. Five are past producers: Afton, Ajax East, Ajax West, Crescent and Pothook; the Big Onion, DM, Python-Makaoo and Rainbow have published reserves but no production.

Mineralization consists primarily of fracture-controlled chalcopyrite and bornite associated with magnetite, while pyrite or pyrrhotite occur peripheral. Mineralization is hosted in all different phases of the batholith. In each case, alteration accompanies mineralization but not all altered zones are mineralized.

Hydrothermal Alteration Assemblages

Early → Late

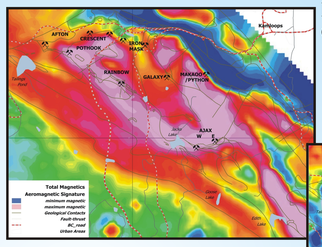


a) magnetite-actinolite-apatite dilatent veins, Afton; b) K-feldspar alteration of Pothook diorite, Audra area; c) pervasive zone of white albitic alteration in metavolcanic Nicola rocks, north of Jacko Lake.

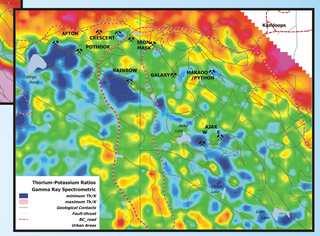
Exploration Parameters

Iron Mask Multi-parameter Airborne Geophysical Survey (Shives and Carson, 1995)

Cu-Au mineral deposits are located along the flanks of broad magnetic highs and coincident eTh/K lows, except for the Crescent. Unexplained coincident anomalies occur north, south and northeast of Edith Lake and north of Jacko Lake.



Total field aeromagnetic response shows the Cu-Au deposits are localized along the margins of the main intrusive body and the boundaries between its separate phases in areas where the presence of magnetite-potassium feldspar-biotite and epidote indicate accompanying potassic alteration.

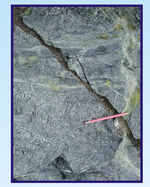


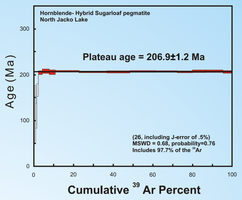
Intrusive Host	Deposit	MTonnes	Cu%	Au ppm	Source
Sugarloaf - Hybrid contact zone	Ajax (mineable+produced)	20.7	0.45	0.34	Ross et al. (1995)
	Pothook (produced)	2.36	0.35	0.77	Lang and Stanley (1995)
	Rainbow (indicated) at 0.35% Cu cutoff	14.8	0.53	0.11	GCNL, 1997; Northern Miner (July, 2005)
Cherry Creek	Afton (mineable+produced)	30.8	1	0.58	Kwong (1987)
	Afton (measured+indicated)	68.7	1.08	0.85	DRC Res. (2004)
	Glen Iron	0.015	magnetite		BC MINFILE
Pothook-Cherry Creek contact zone	Crescent (produced)	1.448	0.44	0.18	Lang and Stanley (1995)
	DM/Audra (indicated)	6.3	0.43	0.24	Northern Miner (July, 2005)
	Big Onion (mineable)	2.4	0.84	0.4	Vollo (1985)
Pothook/Hybrid	Magnet Mine (produced)	0.005	magnetite		1960-1961, BC MINFILE
Nicola-Hybrid Contact Zone	Python/Makaoo (indicated)	0.19	1.11	-	Seraphim 1972, *in* MINFILE
	Iron Mask (produced)	0.16	1.47	0.71	BC MINFILE
Nicola Group	Galaxy (indicated)	0.003	0.65	0.34	BC MINFILE

Geochronology

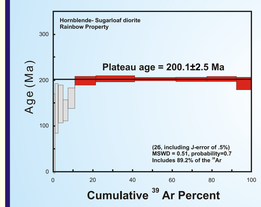
$^{40}Ar/^{39}Ar$ Cooling Ages - Hybrid Amphibolite

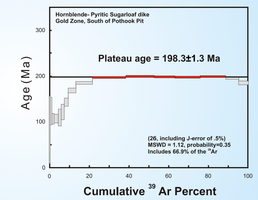
East-west magmatic foliation in Iron Mask Hybrid phase with pegmatitic mineral growth direction (hornblende) perpendicular to the regional foliation, in the direction of dilatency (sample MMI-04-4-1A).





$^{40}Ar/^{39}Ar$ Cooling Ages - Sugarloaf Diorite

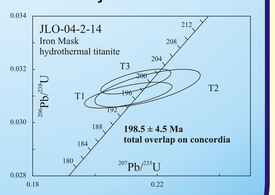




Equigranular leucocratic, hornblende monzodiorite from south east end of Sugarloaf Hill, Rainbow property (sample JLO-04-6-67). Pyritic hornblende porphyritic diorite dike from the Gold zone located south of the Pothook pit (sample MMI-04-1-6).

U-Pb Titanite Age of Mineralization at Ajax West

Vuggy intergrowth of potassium feldspar and albite with calcite, chalcopyrite, pyrite and coarse euhedral crystals of hydrothermal sphene (sample JLO-04-2-14).



Conclusions

- Chemically distinctive hydrothermal systems accompanied each intrusive phase of the batholith: Cu and Au mineralization are associated with potassic alteration related to the Cherry Creek monzonite, and the sodic alteration is associated with Sugarloaf diorite.
- Alteration and mineralization are localized along intrusive contacts between the older Pothook/Hybrid phases and the younger feldspar- and hornblende-phyric phases.
- Mineralized vein arrays at the Magnet and Python mines indicate a northwesterly oriented sinistral shear sense at the time of mineralization. East-west oriented dilatent zones may have accommodated the ore zones at the Afton deposit, intrusive breccias and veins at Crescent and preferred vein sets noted on the DM/Audra zones.
- Structures within the batholith and Nicola Group along the southwest margin of the batholith mainly post-date copper-gold mineralization. Mineral elongation lineations are consistently southeast trending.
- Regional folds may control the gross distribution of intrusive phases and their mineralized zones.

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