

NATURAL RESOURCES CANADA - INVENTIVE BY NATURE

Abstract

Till sampling orientation surveys were completed near the Cu-Mo Gibraltar Mine, the Cu-Au Mount Polley Mine, and the Cu-Mo-Au Woodjam prospect with the objective of defining geochemical and mineralogical indicators of buried Cu porphyry mineralization. Mineralization does not outcrop at Woodjam and was in large part covered by glacial sediments at Gibraltar and Mount Polley Mine at pre-mining time. First, we present the distribution of three indicators at each deposit: 1) Cu concentrations in the clay-sized fraction (<0.002 mm), 2) chalcopyrite grain counts and, 3) epidote grain percentages in the 0.25-0.5 mm fraction (specific gravity >3.2). At each site, the indicators occur in greater concentrations (Cu) or in greater amounts (chalcopyrite and epidote grains) near and down-ice of mineralized zones compared to surrounding background regions devoid of known mineralization. In addition to these three indicators of mineralization, gold grains are more abundant near the Cu-Au porphyry deposit at Mount Polley compared to background levels. Therefore, gold grains are interpreted to be indicative of the Au mineralization. Distribution of these indicators in till are related to the presence of mineralization in bedrock and its dispersal by glacial transport, hence the importance of reconstructing ice-flow histories. Secondly, using till compositional data from a previous project (Mountain Pine Beetle), we test the region of two Late Triassic – Early Jurassic intrusions (Takomkane and Thuya batholiths) for their potential to host Cu porphyry mineralization. Two areas with elevated Cu concentrations, and high chalcopyrite and gold grain counts in till suggest potential for porphyry-style Cu-Au mineralization: 1) th Spout Lake pluton, approximately five kilometres west of the Takomkane batholith, and 2) the north end of the Thuya batholith.

LOCATION MAP



Colpron, M. & Nelson, J.L. 2011. A digital atlas of terranes for the northern Cordillera. British Columbia Ministry of Energy and Mines. BCGS GeoFile 2011-1



Looking to the northwest at a striated moutonnée located 10 km vorthwest of Mount Pollev Mine Striations are oriented 140-320 and the roche moutonnée indicates an ice flow to the NW away from viewer. For scale, the Brunton compass is 22 cm and water bottle 26 cm long.

During the last glaciation, the Gibraltar Mine region was under the influence of Copper concentrations determined by inductively coupled plasma mass three ice movements: 1) to the southeast, 2) to the southwest, and 3) to the spectrometry after a HCl:HNO₃ (1:1) leach on the clay-sized fraction are north to northwest. The movement to the southwest occured before the elevated (>380 ppm) to the west, north and south of the Gibraltar deposit movement to the north to northwest. The relative chronology of the movement to the southeast could not be deciphered on outcrops.

The number of chalcopyrite grains normalized to 10 kg of bulk sediment (< mm; table feed) is more elevated (>10 chalcopyrite grains) to the west, north and south of the Gibraltar deposit compared to surrounding regions.





Where next?

black dashed line on the gold grain map). Note that this area is similar but not identical to the area defined by high copper Till composition results observed at the three porphy Furthermore, along the western margin of the deposits indicate that elevated c patholith. four till samples contain >17 gold clay-sized fraction, and the abundance of chalco grains (Area 2 outlined with a black dashed line) where the Cu be indicative of Cu-Au porphyl grains content of till is >360 ppm. Note that only one sample out of and transported by glaciers. These mineralization eroded two were processed for indicator minerals and gold grain indicators form dispersal trains that extend 2 to 10 km from counts in this region (see Plouffe et al. 2009; 2010 for details) the known mineralization and therefore. can serve to identify the potential presence of buried Cu-Au porphyry mineralization. Furthermore, our results suggest that large Fifty seven archived heavy mineral concentrates from till amounts of epidote in the 0.25-0.5 mm and >3.2 s.g. fraction of samples obtained in the northern sector of the Bonaparte till could be indicative of propylitic alteration associated t Lake map area were processed for porphyry indicator minerals including chalcopyrite grain counts. All samples the porphyry mineralization. with more than 3 chalcopyrite grains per 10 kg are located near the northern end of the Thuya batholith. In addition, one Within the northern sector of the Bonaparte Lake map area. sample with 8 chalcopyrite grains per 10 kg is from the two areas contain a number of till samples with elevated Cu western margin of the Takomkane batholith and is underlain content (>360 ppm): 1) at the northern end of the Thuya batholith (Area 1 outlined with a black dashed line on the Cu by the Spout Lake pluton. map) and 2) along the western margin of the Takomkane batholith (Area 2 outlined with a black dashed line on the Cu We postulate that based on the mineralogical and geochemical indicators of porphyry mineralization identified map) which includes areas of intrusive rocks of the Late in till, the region at the northern end of the Thuya batholith and along the western margin of the Takomkane batholith (Spout Lake pluton) might have potential for porphyry-style Till samples with more than 66 gold grains are present at the mineralization. Additional information can be found in batholith, in an area approximately 10 by 20 km (200 km²: Area 1 outlined with a Plouffe and Ferbey (2015)

Triassic Spout Lake pluton.

northern end of the Thuva

Till geochemistry and mineralogy near Cu-Au and Cu-Mo porphyry deposits in British Columbia; indicators of buried mineralization

Gibraltar Cu-Mo porphyry deposit

showing a distribution pattern similar to chalcopyrite grains. Most of the till samples with >50% green epidote in the 0.25 - 0.5 mm and >3.2 s.g. fraction are located in the region with elevated Cu content in the clay-sized fraction. With few exceptions, samples located more than 10 km from the mine site contain <50% green epidote. The large abundance of epidote grains in till in the region of the Gibraltar deposit is interpreted to be derived from the propylitic alteration.



122°35'

flow.

All samples with >1 chalcopyrite grain are located to the northwest (up to 6 km) or southwest (up to 3 km) of the Bell and Wight deposits with one exception in a sample 9 km to the southeast which contains 2 chalcopyrite grains.



LEGEND

STRATIFIED ROCKS

Oligocene to Pliocene

OPs Conglomerate

Eocene to Oligocene

Endako Group

lesser sedimentary rocks

lesser sedimentary rocks

UTrN Volcanic sandstone-siltstone

Carboniferous - Lower Jurassi

PMCC Undivided marine sedimentary and volcanic rocks

EEs Sedimentary rocks

Lower - Middle Jurassic

Cache Creek Terrane

Cache Creek Complex

Quesnel Terrane

shcroft Formation

Nicola Group

Neogene

Chilcotin Group

METAMORPHIC ROCKS MTm Chlorite-sericite-quartz-feldspar schist; contain zones of foliated granodiorite Basaltic volcanic rocks with NTRUSIVE ROCKS Triassic? Jurassic? Cretaceous? Burgess Creek stock (Border phase) TrKB Quartz diorite, tonalite **FEV** Basaltic volcanic rocks with Middle Cretaceous Sheridan stock (ca. 108 Ma) Quartz diorite, quartz monzonite granodiorite, granite Late Triassic Granite Mountain Batholith (ca. 215 Ma) Melanocratic quartz diorite Polymictic volcanic and plutonic-clast conglomerate LTrGft Foliated tonalite (Mine phase) Upper Triassic and Lower Jurassic LTrGIt Leucocratic tonalite, trondhjemite (Granite Mountain phase)

POLLYANNA Dpen pit

♠ ♠ Glacial striations (paleo ice-flow direction) $(\mathbf{U}$ known, unknown) MINFILE Porphyry Cu+/- Mo +/- Au

Fault

- Cu-Mo setting unknown Lacustrine diatomite
- Sub-bituminous coal

Geology simplified from Ash et al. (1999), Massey et al. (2005) and Schiarizza (2014)

gold grains (0.15-0.150 mm |norm. /10 kg <2 mr



Till geochemistry data from Plouffe et al. (2010).

Mount Polley Cu-Au porphyry deposit

Two ice-flow movements have been determined in the Mount Polley region: 1) an earlier west-southwestward movement, followed by 2) a later northwestward

Similarly, all samples with Cu values >380 ppm are located over and up to 3.5 km northwest (down-ice) of the deposits with one exception located approximately 6 km to the southeast (up-ice). Samples containing 15% - 90% green epidote in the 0.25-0.5 mm and >3.2 s.g. fraction are located over, to the southwest (up to 3 km), and to the northwest (up to 3.5 km) of the Mount Polley Intrusive Complex.



Fill mineralogy data in Plouffe and Ferbey (2015)

Early Jurassic Undifferentiated granodiori monzonite and quartz feldspar porphyry Undifferentiated diorite. clinopyroxenite Late Triassic - Early Jurassic Undifferentiated felsic and n intrusive rocks Undifferentiated volcanic and associated sedimentary rocks Ravfield River phase lornblende alkali feldspar syenite ——— Fault Undivided: pillowed basalt, chert, slate,

Conglomerate, sandstone, siltstone

Sandstone, conglomerate

Carboniferous - Permian

Siltstone, limestone, chert

siltstone, gabbro, diabase and schist

Snowshoe Group and Eagle Bay Assemblage

Undifferentiated, micaceous quartzite,

Harper Ranch Group

Slide Mountain Terrane

Proterozoic - Paleozoic

and foliated granodiorite

KootenayTerrane

Carboniferous - Permian

Upper Triassic and Lower Jurassic

Quesnel Terrane

Lower Jurassic

Nicola Group

The bedrock geology was simplified from Campbell a Tipper (1971), Schiarizza et al. (2002a; 2002b; 2002c; 2009a; 2009b), Schiarizza and Boulton (2006a; 2006b), Schiarizza and Bligh (2008), and Anderson e al. (2010), and was based on the compilation presented in Plouffe et al. (2011).

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Woodjam Cu-Mo-Au porphyry prospect

Two ice movements have been identified in the Woodjam area: 1) a first one to the southwest and 2) a later one to the northwest.

The two highest Cu values in till occur immediately adjacent to the Deerhorn zone (400 and 410 ppm Cu). Samples with >225 ppm Cu occur: 1) down-ice (southwest) of the Takom zone, 2) at the southwest end of Horsefly Lake (235 ppm), and 3) at approximately 14 km northwest of Deerhorn zone (231 ppm).

All samples with >9 chalcopyrite grains are located proximal to known mineralized zones at Woodjam. Till samples with >25% green epidote in the 0.25-0.5 mm and >3.2 s.g. fration are located within 2 km of known mineralized zones. Two exceptions are located 4 km northeast of the Southeast zone and 10 km west-southwest of Three Firs where epidote is present as 40% of the 0.25-0.5 mm and >3.2 s.g. fraction. Throughout the rest of the study area, epidote content in this size/density fraction of till is generally ≤25%.



Late Triassic - Early Jurass Undifferentiated felsic and intrusive rocks Late Triassic Spout Lake pluton

Monzodiorite, monzonite, di

Corp. (Mount Polley Mine). We acknowledge professional services provided by Overburden Drilling Management Ltd. (Ottawa, ON) for heavy mineral separation and identification and ACME Analytical Laboratories (Vancouver, BC) for geochemical analyses. This publication benefited from the GSC internal review completed by I. McMartin.

An overview of the till geochemistry mineralogy results contributed by this TGI-4 project is provided in Plouffe and Ferbey (i

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