Porphyry Indicator Minerals (PIMS): A New Exploration Tool for Concealed Deposits in south-central British Columbia

Farhad Bouzari, Craig JR Hart, Shaun Barker and Thomas Bissig
MDRU, Mineral Deposit Research Unit, University of British Columbia, Canada

Why PIMS?
The common occurrence of resistate minerals as alteration products in BC porphyry copper deposits suggest that these minerals could be utilized as porphyry indicator minerals (PIMS) and potentially provide a new exploration tool for BC explorers. This research project has successfully recognized, characterized and documented the occurrence, types, relative abundances and compositions of selected resistate minerals in several BC porphyry deposits.

- Porphyry indicator minerals (PIMS), such as apatite, rutile, garnet and titanite, are associated with porphyry copper deposits and resistant to weathering.
- PIMS display unique properties such as color, shape, luminescence and composition.
- Improved understanding of these minerals could provide a key tool to increase exploration targeting success, especially in glacial, fluvial and regolith terrains.

BC PORPHYRY COPPER BELTS UNDERCOVER

- The Quesnel and Stikine terranes in south-central BC host magmatic arcs, which are highly prospective for porphyry deposits.
- However, exploration success in this area has been limited due to extensive veneers of till and related glacial sediments especially in the region between the Mount Milligan and Mount Polley porphyry deposits.

OBJECTIVES
- Determine the occurrence and types of resistate minerals in various styles of alteration and mineralization in several central BC porphyry copper-gold deposits.
- Determine the diagnostic physical parameters and chemical compositions of resistate minerals.
- Identify important indicator minerals and establish physical properties to distinguish those resistate minerals that are directly associated with porphyry Cu-Au deposits.
- Establish criteria for use of PIMS as an exploration tool.

HYDROTHERMAL ALTERATION ASSEMBLAGES

Porphyry copper mineralization is commonly associated with felsic intrusive bodies and is overprinted by K-silicate alteration assemblages. Muscovite, e.g. phyllic alteration, occurs in calc-alkaline porphyry deposits such as Highland Valley:
- Fresh Bethsaida granodiorite, the main host-rock to mineralization at Highland Valley, with rounded quartz phenocrysts and biotite books.
- Stockwork of K-silicate alteration of K-feldspar and biotite overprinting Bethsaida granodiorite.
- Intense green mica alteration and associated sulfide mineralization overprinting the Bethsaida granodiorite.

MAGNETITE CHARACTERISTICS

- Magnetite in fresh host-rocks displays uniform pink color of hematite and commonly has a rim of hematite or titanite.
- Magnetite in altered host-rocks has remnant of pink Ti-magnetite replaced by hematite. Spongy hematite cemented by hydrothermal quartz occurs with more advanced alteration stages of magnetite.

CONCLUSIONS
- Apatite grains with altered host-rocks have green and grey CL color and have lost many of their trace components such as Mn, Na, Cl, S and REE.
- Porphyry-altered apatite and magnetite can be easily recognized visually and geochemically.

ACKNOWLEDGEMENTS: We would like to thank Teck Corporation, Terrane Metals and Imperial Metals for allowing access and sampling at their properties. Geoscience BC is thankful for its generous financial contribution in support of this project.