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Modelling Overburden Thickness to Better Evaluate Porphyry Deposit Prospectivity in the Central Quesnel Terrane of BC

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Public Data and References

BC Geological Survey (2020): MINFILE BC mineral deposits database; BC Ministry of Energy, Mines and Petroleum Resources, BC Geological Survey, URL <http://minfile.ca> [July 2019].

BC Ministry of Energy, Mines and Petroleum Resources (2020): Assessment Report Indexing System (ARIS); BC Ministry of Energy, Mines and Petroleum Resources, BC Geological Survey, URL <https://www2.gov.bc.ca/gov/content/industry/mineral-exploration-mining/british-columbia-geological-survey/assessmentreports> [May 2020].

BC Ministry of Environment and Climate Change Strategy (2020): Groundwater wells database, URL <https://catalogue.data.gov.bc.ca/dataset/groundwater-wells> [October 2020].

Colpron, M. and Nelson, J.L. (2011): Yukon terranes – a digital atlas of terranes for the northern Cordillera; Yukon Geological Survey, URL <http://data.geology.gov.yk.ca/Compilation/2> [November 2020].

Cui, Y., Miller, D., Schiarizza, P. and Diakow, L.J. (2017): British Columbia digital geology; BC Ministry of Energy, Mines and Petroleum Resources, BC Geological Survey, Open File 2017-8, 9 p, URL <http://cmscontent.nrs.gov.bc.ca/geoscience/PublicationCatalogue/OpenFile/BCGS_OF2017-08.pdf> [June 2019].

Geotech Ltd. (2008): Report on a helicopter-borne versatile time domain electromagnetic (VTEM) geophysical survey: QUEST project, central British Columbia (NTS 93A, B, G, H, J, K, N, O and 94C, D); Geoscience BC, Report 2008-4, 35 p., URL <http://www.geosciencebc.com/i/project_data/QUESTdata/report/7042-GeoscienceBC_final.pdf> [June 2019].

Logan, J.M. and Schiarizza, P. (2011): Geology of the Quesnel and Stikine terranes and associated porphyry deposits; Geoscience BC Workshop: Exploration Undercover; a practical example using the QUEST study area, URL <http://www.geosciencebc.com/i/pdf/Presentations/UnderCover/WS2011/Talk_4_Schiarizza.pdf> [January 2020].

Maynard D.E., Ward B.C., Geertsema M., Roberts N., and Sacco D. (2010): Relative drift thickness map, north-central BC, (93G, 93H/w, and 93I/s); Geoscience BC, Map 2010-14-1, scale 1:250 000, URL <http://cdn.geosciencebc.com/project_data/GBC_Report/2010-14/GBC_Map_2010-14-1.pdf> [June 2019].

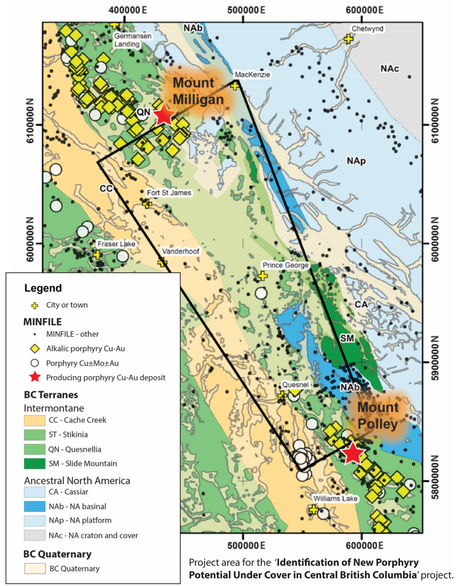
Mira Geoscience Ltd. (2009): QUEST Project: 3D inversion modelling, integration, and visualization of airborne gravity, magnetic, and electromagnetic data, BC, Canada; Geoscience BC, Report 2009-15, 87 p., URL <http://www.geosciencebc.com/i/project_data/GBC_Report/2009-15/Report/Mira_AGIC_GeoscienceBC_Quest_Geop_Modelling_Report_2009-15.pdf> [June 2019].

Natural Resources Canada (2020): Canadian Airborne Geophysical Data Base; Airborne Geophysics Section, Geological Survey of Canada, Lands and Minerals Sector, Natural Resources Canada, URL <http://gdr.agg.nrcan.gc.ca/gdrdap/dap/search-eng.php> [October 2019].

Quesnel Terrane Undercover Porphyry Potential

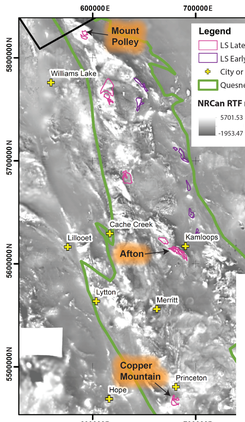
The Quesnel terrane of British Columbia is well known in the mineral exploration community as a terrane that is well endowed in porphyry Cu-Au mineralization. Past-producing, currently producing, and developed porphyry deposits are aligned the length of the Quesnel terrane, with an obvious, approximately 300 km gap in occurrences between the currently producing Mount Milligan and Mount Polley porphyry Cu-Au deposits. The overall high porphyry prospectivity to the north and south of this region suggests that new porphyry deposits are yet to be discovered within this gap, but extensive Quaternary cover has been an inhibiting factor for exploration.

Publically available geophysical data holds great potential to provide insight into the geology of the drift-covered central Quesnel terrane. The '**Identification of New Porphyry Potential Under Cover in Central British Columbia**' project, part of Geoscience BC's Central Interior Copper-Gold Research series focuses on gaining a better understanding of overburden thickness variability and related implications for porphyry deposit exploration in BC. Consolidating knowledge of overburden thickness and buried geology will help explorers know where to focus efforts and gain insight for future exploration, geophysical and geochemical survey design, and mine development.



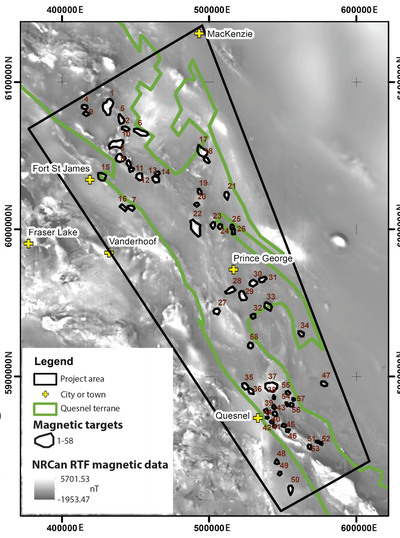
Project area for the '**Identification of New Porphyry Potential Under Cover in Central British Columbia**' project.

BC Alkalic Cu-Au Porphyries and Magnetics



Logan and Schiarizza (2011) outlined two belts of alkalic intrusions in the southern Quesnel terrane. These alkalic intrusions, many of which have associated porphyry mineral occurrences and deposits, are strongly correlated with magnetic anomalies. Based on this observation, a suite of similar magnetic targets within the 'gap' between the Mount Milligan and the Mount Polley deposits was selected. These interpreted intrusive targets are the focus of this project, and their prospectivity as porphyry hosts or sources is followed up with consideration of regional overburden thickness and other geophysical and geological characteristics.

Alkalic-intrusive suites identified within the southern Quesnel terrane by Logan and Schiarizza (2011) are indicated by 'LS' in the legend. The western Late Triassic alkalic belt is shown in pink and the eastern Early Jurassic alkalic belt is shown in purple. Several Cu-Au porphyry deposits are indicated, each of which is correlated with magnetic host or source intrusions. Background is NRCan residual-total-field magnetic data (Natural Resources Canada, 2020). The Quesnel terrane is outlined in green. Abbreviation: nT, nanotesla

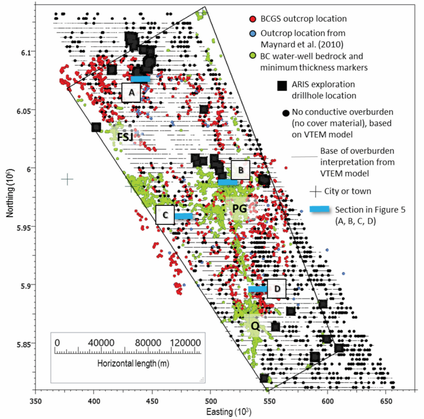


Magnetic targets selected for investigation (outlined in black; n = 58) superimposed on the Natural Resources Canada residual-total-field magnetic data grid (Natural Resources Canada, 2020). The Quesnel terrane is outlined in dark green, and the project area lies within the black quadrilateral. Abbreviation: nT, nanotesla.

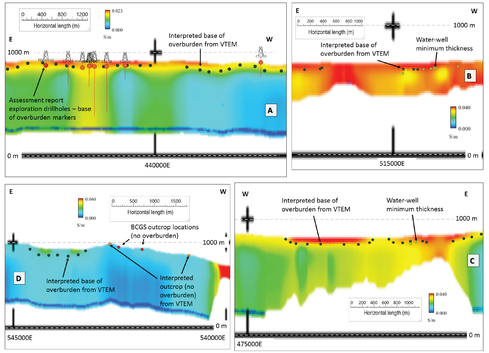
VTEM Conductivity and Overburden Thickness Constraints

Overburden-thickness modelling was undertaken to improve on current knowledge of the distribution and thickness of surficial geological material across the central Quesnel terrane. Such information is critical to improving target ranking and exploration decision-making.

VTEM data (Geotech Ltd., 2008, > 11,600 line-km of data through the central Quesnel Terrane), have been shown to effectively detect, and provide reasonable estimates of overburden depth. The VTEM data were inverted in 1-D to generate conductivity models along each survey line (Mira Geoscience, 2009). Two types of overburden-thickness constraints are extracted from VTEM inversions: 1) base of conductive overburden, and 2) locations of no apparent overburden.



Constraining data used for overburden-thickness modelling. Constraining data from VTEM inversion models are derived from interpretations digitized along line on east-west VTEM lines spaced 4 km apart. Project area lies within the black quadrilateral. Abbreviations: PG, Prince George; FSJ, Fort St. James; Q, Quesnel.

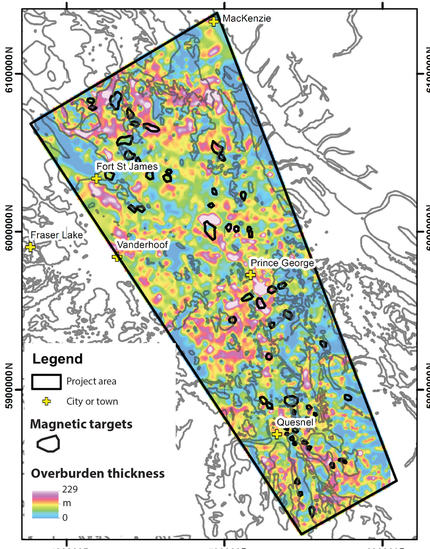


Vertical cross-sections through VTEM conductivity inversions showing correlation between high-conductivity layers resolved near surface and the presence of overburden as indicated in exploration-drilling, water-well and outcrop data. Vertical scale is elevation with 2x exaggeration. Section locations A–D are shown in the above figure. Abbreviation: S/m, siemens/metre.

Updated Overburden Thickness Model

The addition of detailed constraints from VTEM interpretations results in more detail about overburden thickness in areas that are difficult to access for mapping, and gives a sense of the significant variability in thickness through the region.

Based on this model, the overburden thickness ranges from 0 to 297 m and averages 36 m. Most of the magnetic targets identified for this project occur beneath <50 m of overburden according to the model. The thickest overburden areas, with >200 m modelled thickness, occur south of Prince George, about 40 km northwest of Prince George, and in the northernmost part of the project area.



Overburden-thickness model of the project area. Quaternary geology (Cui et al., 2017) shown in dark grey outline.

Future Work

Work on additional geophysical characteristics of key magnetic targets will continue and include comparisons to geophysical responses associated with other known porphyry-related intrusions north and south of the project area (north and south Quesnel terrane). An updated gravity inversion will be completed using the overburden-thickness model to refine bedrock-density estimates which will be used in target prioritization. An additional VTEM inversion, deriving induced-polarization effect, will be run to generate a model that provides information about the chargeability of rocks across the project area.

The most prospective interpreted intrusive targets chosen on the basis of geophysical and geochemical characterization will be modelled in 3-D using magnetic inversions to provide details on their shape, size, depth and magnetic properties. Combined with overburden thickness data, this information will further inform mineral explorers on the physical parameters of the target, which will help guide prospecting, planning of local geochemical and geophysical surveys, and drilling.