Porphyry Districts of British Columbia Atlas Series

MT. MILLIGAN

A geo-exploration atlas of the Mt. Milligan porphyry copper-gold district

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Compiled by F.A.M. Devine, P. Kowalczyk, and D. R. Heberlein

Geoscience BC

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The recommended reference for this publication is as follows:

Devine, F.A.M., Kowalczyk, P., Heberlein, D.R. (2022): A geo-exploration atlas of the Mt. Milligan porphyry copper-gold district; Geoscience BC, Report 2022-04, URL <https://www.geosciencebc.com/projects/2010-002/> [May, 2022]

Acknowledgements:

Thank you to C.P. Jago for a very helpful and informative review, and to M. Pond for continued support of the atlas series and this Mt. Milligan atlas. Thanks to C.M. Rebagliati for an introduction to the exploration history of the area, including the story of discovery in 1983. Thanks to Thompson Creek Metals, and subsequently Centerra Gold for their support and access to information and data, and to D. Mitchinson for early sharing of compiled data from the project area.

Cover photo: The open pit at Mt. Milligan Mine (Centerra Gold website; URL https://www.centerragold.com/cg-raw/cg/multimedia/photo-gallery/mm-24.jpg [May, 2021])

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INTRODUCTION

The Mt. Milligan porphyry copper-gold deposit is located in the Nechako region of central British Columbia (Fig.1), near the southern limit of the Swannell Range of the Omineca Mountains. The deposit is the first porphyry deposit within Quesnel terrane to be encountered north of a large region, approximately 200 kilometres long, of relatively continuous surficial cover in central British Columbia.

Production at the mine commenced in February 2014, mining a mineral reserve (proven and probable) of 482.4 million tonnes at 0.200% copper and 0.388 g/t gold, containing 2.124 billion pounds of copper and 6.02 million ounces of gold (Mills et al., 2009). The overall measured and indicated resource at the comencement of mining was 706.7 million tonnes at 0.182% copper and 0.330 g/t gold (Mills et al., 2009). Mining of the deposit is currently underway (Figs. 2 and 3), under the ownership of Centerra Gold Inc..

Mt. Milligan is an silica-saturated, alkalic type porphyry copper-gold system, developed around a suite of Early Jurassic monzonitic to monzodioritic intrusions emplaced into Upper Triassic volcanic rocks of the Takla Group, part of the Quesnel terrane. Dated at ca. 182 Ma (Mortensen et al., 1995; Nelson and Bellefontaine, 1996) it is one of the youngest alkalic porphyry deposits in the Triassic-Jurassic arc terranes of British Columbia. Other known Early Jurassic alkalic pophryry mineralization occurs at several locations to the north within this part of central Quesnellia, making the region considerably prospective for similar-aged systems.

Although Mt. Milligan was discovered by prospecting, subsequent regional geochemistry surveys variably identify the Mt. Milligan deposit, and other possible targets within the region. At the deposit scale, soil geochemistry highlights known mineralization, and deposit-scale geophysical surveys have proven to correlate well with particular types of mineralization. Brownfields exploration is underway and some of the interesting soil and geophysical anomalies may yet lead to additional discoveries in the near-mine area.

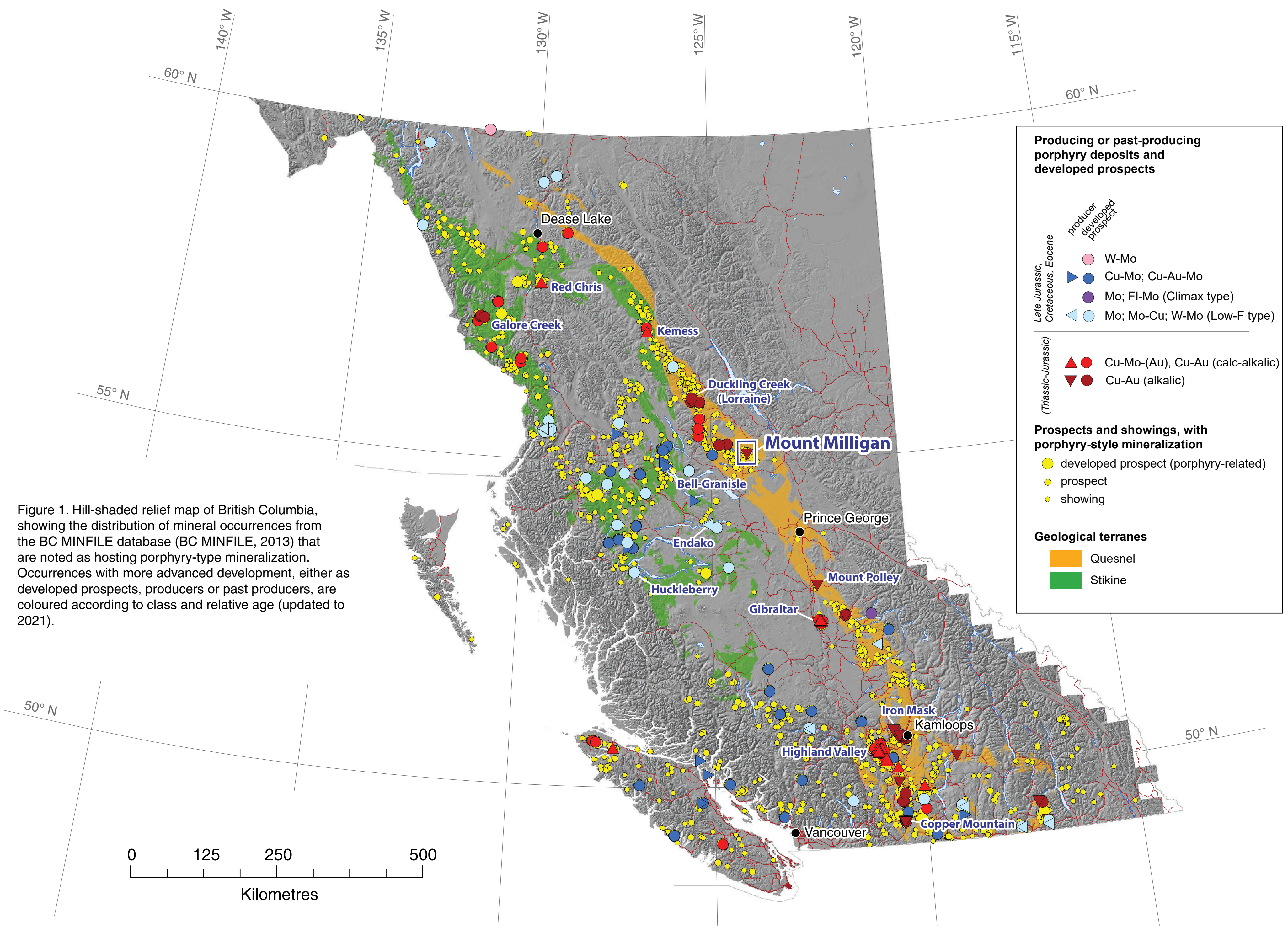

Figure 1. Hill-shaded relief map of British Columbia, showing the distribution of mineral occurrences from the BC MINFILE database (BC MINFILE, 2013) that are noted as hosting porphyry-type mineralization. Occurrences with more advanced development, either as developed prospects, producers or past producers, are coloured according to class and relative age (updated to 2021).

Figure 2. View of pit development at Mt. Milligan Mine in June 2017, looking south. (https://www.centerragold.com/cg-raw/cg/Mt_Milligan_Mine-Tour_June_2017-v2a.pdf [April, 2021])

Figure 3. The mill at Mt. Milligan Mine. Credit Centerra Gold, from www.canadianminingjournal.com [May, 2021]

HISTORY OF EXPLORATION & DEVELOPMENT

The first claims staked in the immediate vicinity of the Mt. Milligan deposit were located in 1972 at the east end of Heidi Lake, named the Mosquito-Zap claims owned by Pechiney Development Ltd. What originally led to their interest in the area is not certain. The eastern claim boundary from this time falls near the modern day western pit limit. From 1972 to 1975 Pechiney Development Ltd. conducted fly-in exploration including soil surveys for copper, IP and magnetics geophysics, followed by drilling four diamond drill holes (Berthault, 1973; Hallof and Goudie, 1973; Guelpa, 1974; Guelpa, 1975). They encountered consistent quartz-epidote-pyrite alteration of andesitic volcanic rocks with local feldspar porphyry intrusions. Pyrite and minor chalcopyrite was observed in veinlets. Results did not justify further exploration and the claims were allowed to lapse (Sketchley, 1992).

The events leading up to the discovery of the Mt. Milligan deposit began in 1983. Based upon research by Mr. R. Farmer, who recognized the potential in reports from the earlier 1970's work by Pechiney Development (Heberlein et al., 1984), an exploration team for Selco Inc. staked a large claim group extending from north of Mitzi Lake down to the east end of Heidi Lake (Phil 1 - 12 claims). This included the area of the previous Mosquito-Zap claims, and encompassed the area immediately west of the current Mount Milligan mine, in an area known as the Brownfield-Greenfield exploration area (Fitzgerald et al., 2020). Access was by float plane or helicopter from logging roads into the Philip Lakes region. During the same season in 1983, prospector Richard Haslinger was also exploring the area and discovered copper-gold mineralized outcrop in the Creek zone (now called the Saddle zone). By early 1984 Mr. Haslinger had staked the Heidi claims adjoining the Phil claims to the east. Most of the modern deposit limit is located within these original Heidi claims. Selco amalgamated with BP Resources Canada Inc. in early 1984, and BP Resources continued exploration, optioned the Heidi claims from Mr. Haslinger, and staked additional claims to the south and east of the Heidi claims.

Important to the discovery of the Mt. Milligan deposit and outlying mineralized zones was a set of extensive soil surveys carried out early in the program by the BP Resources team (Heberlein et al., 1984). A continuous grid over 5 km north-south by 5 km east-west including over 2200 samples formed part of the initial suite of exploration data that led to further work. The pyrite-dominant auriferous mineralization on the North Slope that had originally drawn the attention of the Selco team was now seen to be more varied and widespread to the east, into copper-gold mineralization associated with domains of K-feldspar alteration. Further work to follow-up on the soil anomalies identified in this soil geochemistry data was guided by an awareness of glacial transport direction and interpretation of soil anomalies in the more broadly till-covered eastern part of the area (Heberlein et al., 1984). Ground based geophysics (IP and ground magnetics), as well as geological mapping (although limited by lack of extensive exposure), and trenching were all part of the exploration program at this time.

Lincoln Resources entered in 1986 through an agreement with BP Resources to earn a 51% interest (later increased to 69%) in the project. Lincoln hired Mr. C.M. Rebagliati, who had been part of the original Selco and BP Resources teams, to manage the continuation of the exploration program. They quickly moved to drilling of the targets identified through the BP Resources exploration programs. Early drilling in February-March 1987 focused on the Esker and Creek zones (now part of what is called the Saddle zone), with results indicating high gold values in pyritic mineralization within northeast-oriented structures, and moderate potassic alteration with quartz-sulphide veining. The physical exploration work continued, including a ground magnetic survey over the Magnetite Breccia Zone (MBX zone) in 1987 (Rebagliati, 1987). The magnetic anomaly identified in this survey also had coincident IP and soil geochemical anomalies and was the focus of the second drill campaign beginning in September 1987 (Rebagliati, 1988a). Drill holes 87-12 and 87-13 returned 50.51 metres grading 0.6 g/t gold and 0.24% copper, and 97 metres grading 0.62 g/t gold and 0.27% copper, respectively, the first holes to identify appreciable Au-Cu mineralization associated with potassic and sericitic/silicic alteration (Rebagliati, 1988; Fitzgerald et al., 2020). These two types of alteration are now recognized to be associated with two overprinting stages of mineralization (C.P. Jago, pers. comm. 2022).

In 1988 Lincoln Resources reorganized to become United Lincoln Resources (Titley, 1991). Drilling continued through the 1988 season resulting in an additional 32 diamond drill holes into the MBX and Esker and Creek zones (Rebagliati, 1988b; Rebagliati, 1989). The successful outcome was recognition of the potential scale of the Au-Cu mineralization in the MBX zone, and the further potential for peripheral gold mineralization.

In 1989, Continental Gold Corp. and United Lincoln amalgamated and continued on under the name Continental Gold Corp. The 1989 season saw a major drilling campaign on the property, with 87,662 metres of diamond drilling over 336 holes (Fitzgerald et al., 2020). An overburden drilling program was also executed (Rebagliati,1989). Additional claims were staked to the north up to and including Mount Milligan proper (the topographic feature), geological mapping and prospecting were conducted (Forster, 1989) and an airborne VLF-EM and magnetic survey was flown over the entire claim block (Bradley and Forster, 1989). The drilling program outlined nearly all of the zones that today form the Mt. Milligan deposit (Fitzgerald et al., 2020).

The exploration push continued into 1990 with infill diamond drilling in the MBX and Southern Star and surrounding areas. The program was taken over by Placer Dome Inc. in late 1990, and their subsidiary PDI Subco became the primary owner of the project by early 1991 (Titley, 1991). The focus now included seeking regulatory approval for the project and in April 1991 a Pre-Feasibility Study was produced, with continued of exploration, metallurgical, geotechnical, and condemnation drilling.

Under Placer Dome's management, exploration continued with geological and geophysical work in areas of interest near to and outboard of the deposit area. IP, ground magnetics, and VLF-EM surveys were conducted over numerous targets, and a small exploratory DIGHEM survey was flown. And understanding of the geophysical signatures of the deposit and target areas was developed. However, by 1992 the project was deemed sub-economic by Placer Dome. The project was revisited in 1996 with an updated geological model and a variety of development scenarios were investigated (Fitzgerald et al., 2020), but with no immediate consequence.

The year 2004 saw a revitalization of interest in the Mt. Milligan deposit. Placer Dome compiled and reprocessed historic data into a GIS database and developed a 3-D geological model. Samples from previous drill programs were revisted and reanalyzed, and a project was conducted in 2005 to examine the geochemical footprint of the deposit area and near-deposit distribution (Lustig and Fonseca, 2006). An M.Sc. study by C.P. Jago was initiated at The University of British Columbia at this time to investigate alteration and mineralogical zoning in the system (Jago, 2008).

2006 saw significant changes in control of the project. In May, 2006 Barrick Gold Corp. purchased Placer Dome. The Canadian assets were sold to Goldcorp Inc., who sold Mt. Milligan to Atlas Cromwell Ltd. (Lustig, 2006). By July 2006 Atlas Cromwell was renamed Terrane Metals Corporation (Fitzgerald et al., 2020).

Under Terranes Metals' management the project saw additional drilling, both geotechnical and exploration, as well as additional geological and regional stream sediment geochemistry work. There was also a strong focus on airborne and ground-based geophysics with the intention of seeing through overburden in the deposit and outlying areas. HeliGEOTEM II and ZTEM (through a partnership with Geoscience BC) were both employed at this time (Fugro Airborne Surveys, 2008; Geotech Limited, 2009). In 2009 ground-based IP was conducted over several of the HeliGEOTEM II anomalies, including in the Mitzi Lake area where anomalies were followed up on with a soil geochemistry (Heberlein, 2010a). A soil orientation survey investigated the performance of various analytical methods in the deposit area (Heberlein, 2010b). A Titan-24 survey was also completed in 2010 over the deposit area (Martinez del Pino and Eadie, 2010).

In late 2010 Thompson Creek Metals Company Inc. acquired Terrane Metals Corp. They continued with some follow-up drilling on the Titan-24 anomalies. The focus had shifted to mine development with continuation of the feasibility work already initiated by Terrane (Mills et al., 2009). Mine construction began in mid-2010 and production of a copper and gold concentrate commenced in February, 2014, with a projected 22 years of production (Mills et al., 2009) which was updated by December 2014 to 24 years to produce 919,000 tonnes of copper and 4,481,000 ounces of gold (Clifford and Berthelsen, 2015).

Centerra Gold Inc. acquired Thompson Creek in 2016. Mining continued and as of the end of 2019 a projected 9 year mine life remained (Fitzgerald et al., 2020).

REGIONAL GEOLOGY

The Mt. Milligan deposit is located within Quesnel terrane, a volcanic arc domain that extends the length of British Columbia and is host to many of the Province's most significant porphyry deposits. Quesnel terrane and the other components of the Intermontane terranes represent a series of volcanic island arcs and intervening marginal oceanic domains ranging from Late Paleozoic to Early Jurassic in age that were accreted to the North American continental margin by the Middle Jurassic (Mihalynuk et al., 1994; Nelson and Colpron, 2007).

In central British Columbia, at the latitude of the Mount Milligan mine, Quesnel terrane is juxtaposed to the west with the oceanic Cache Creek terrane across the terrane-bounding Pinchi Fault. Farther west, the Cache Creek terrane is juxtaposed to the west against the Stikine terrane, a similarly aged composite volcanic arc terrane as Quesnel terrane, across the terrane-bounding Takla fault. To the east a series of east-vergent thrust faults, younger west-vergent thrust faults and high-angle transcurrent faults separate Quesnel terrane from the oceanic Slide Mountain terrane and the Cassiar Platform, which includes parautochthonous carbonate and siliciclastic strata formed along the passive margin of Ancestral North America. Fault relationships were established in the Early to Middle Jurassic during amalgamation and final accretion of the Intermontane terranes to the North American margin, however subsequent transcurrent movement in the Early Cretaceous and Eocene have modified these boundaries and fault systems.

The Mesozoic rocks of Quesnel terrane in north-central British Columbia represent the Quesnel arc which formed in two phases of development. Middle to Upper Triassic Takla Group shoshonitic volcanic and volcaniclastic rocks comprise a series of layered successions and discrete volcanic centres that form the most voluminous and well-exposed units in the region. In the region around Mt. Milligan, Takla Group is represented by the Witch Lake succession, a layered sequence of augite-phyric andesitic volcaniclastic and coherent rocks. A hiatus in volcanism was followed by the Early Jurassic deposition of the Chuchi Lake and Twin Creek successions which are more heterogeneous but contain shoshonitic volcanic units and sedimentary components (Nelson and Bellefontaine, 1996).

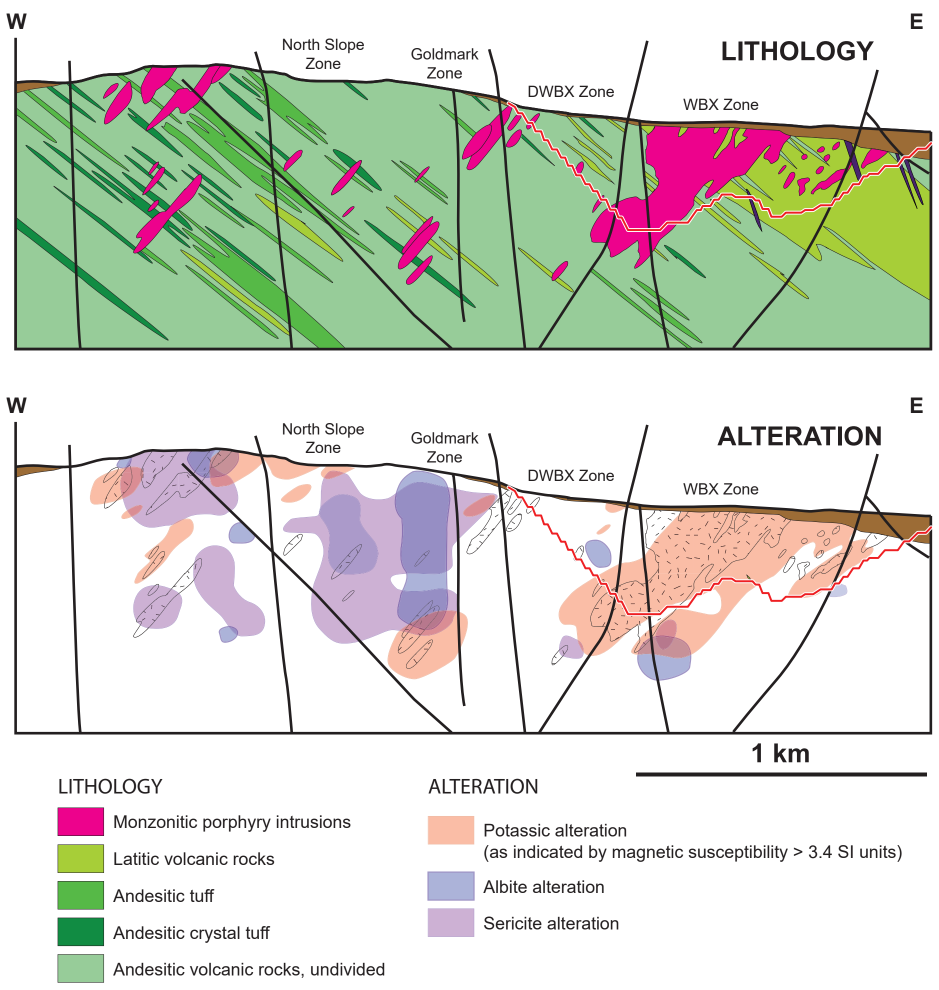

Figure 4. Cross section line 6,109,500 N showing a recent interpretation of the lithology and alteration along the line. The northeastward tilting of the montonitic intrusions and correlative tilting of layered volcanic host rocks is showing in the lithology section. General alteration pattern is shown in the lower section, demonstrating the predominantly potassic WBX zone and peripheral, fault-offset, albitic and sericitic alteration. Simplified from Fitzgerald et al. (2020).

The Mt. Milligan (or Nation Lakes) region is widely covered by Takla Group (Late Triassic) volcanic rocks and overlying younger sedimentary and volcanic sequences, intrusive rocks include Late Triassic, Early Jurassic and Cretaceous plutons. Approximately 50 kilometres west-northwest of the deposit is the southern limit of the Hogem batholith, a regionally extensive composite intrusive complex within the northcentral BC part of Quesnel Terrane.

While the region of Quesnel Terrane is also prospective for porphyry Cu-Au systems of latest Triassic age, a 6-m.y. pulse centred on 205 Ma (Logan and Mihalynuk, 2014) including Mt. Polley and Kwanika, the Mt. Milligan deposit belongs to a group of younger Early Jurassic alkalic porphyry systems. Emplacement of the younger group is correlative with the second phase of arc development coeval with the deposition of the Twin Creek and Chuchi Lake volcanic successions. There are other mineralized alkalic porphyry prospects in the southern Hogem batholith area that are associated with Early Jurassic monzonitic to syenitic intrusions (eg. Chuchi), and farther north in the central part of the batholith, the Lorraine deposit is another known Early Jurassic alkalic Cu-Au deposit (~178 Ma, Devine et al., 2014) associated with syenitic rocks. Together, these Early Jurassic intrusions and locally associated Cu-Au mineralization represent a discrete alkalic intrusive event ca. 188 - 178 Ma that coincides with the late stages of accretion of Quesnel Terrane and associated Intermontane terranes to the Ancestral North American margin.

GEOLOGY OF THE MT. MILLIGAN DEPOSIT

The Mt. Milligan area is predominantly underlain by Upper Triassic Witch Lake succession, a package of shoshonitic layered coherent and clastic andesites (Barrie, 1993; Jago, 2008). In the northwesetern part of the property the volcanic rocks are intruded by the Early-Middle Jurassic Mount Milligan Pluton (Nelson and Bellefontaine, 1996) which is exposed at surface approximately 5 to 9 kilometres north of the deposit area.
Regional magnetic surveys show that the intrusive complex may extend southeastward in the subsurface toward the deposit area where specific intrusions of the Heidi Lake monzonite stock cluster form the intrusive core of the deposit (Map 7.1, this atlas).

In the deposit area, the volcanic rocks on average dip moderately (30-35 degrees) towards the east-northeast (Jago, 2008; Jago et al., 2014), and the intrusive stocks have a westward component of plunge that together indicate that the mineralized system has been tilted towards the east (Fig. 4; Sketchley et al., 1995; Jago, 2008). This tilting, along with syn- and post-mineral high-angle extensional faults have exposed different parts and relative depths of the deposit. Reconstructing the deposit alteration and mineral zoning has had to account for these structural offsets, as mineralogy and grade can change suddenly across structures (Jago, 2008; Jago et al., 2014)

The deposit is centered on several relatively late intrusions of the Heidi Lake monzonite stock cluster. The intrusions are Early Jurassic (ca. 182 Ma ± 4 Ma; Mortensen et al., 1995; Nelson and Bellefontaine, 1996) and represent the intrusive equivalent of the Lower Jurassic Chuchi Lake succession mapped elsewhere in the region (Nelson and Bellefontaine, 1996). The intrusions are monzonitic, and variably plagioclase-phyric. Two of the stocks, the Magnetite Breccia stock and the Southern Star stock form the centres of the two main areas of Au-Cu mineralization (Fig. 5). The Magnetite Breccia stock is a crowded plagioclase-phyric quartz monzonite to monzodiorite intrusion with hydrothermal breccia along it's margins and a northwest-striking elliptical shape (Fitzgerald et al., 2020). The Southern Star stock is a composite body of feldspar-phyric monzonitic intrusions with extensive hydrothermal breccia.

Potassic alteration is focused along the margins of the Magnetite Breccia and Southern Star stocks and decreases in intensity both inwards towards the cores of the intrusions, and outwards into the volcanic rocks (Fitzgerald et al., 2020; Jago et al., 2014). The assemblage of biotite - K-feldspar - magnetite ± actinolite defines the potassic domain, with K-feldspar dominant alteration within the stocks and biotite dominant alteration with accessory actinolite within the adjacent volcanic rocks (Jago, 2008; Jago et al., 2014). Where the potassic alteration is most intense, clots of hydrothermal biotite (in the stocks) or primary ferromagnesian minerals (within the andesites) are replaced by chalcopyrite ± pyrite - magnetite (Jago et al., 2014).

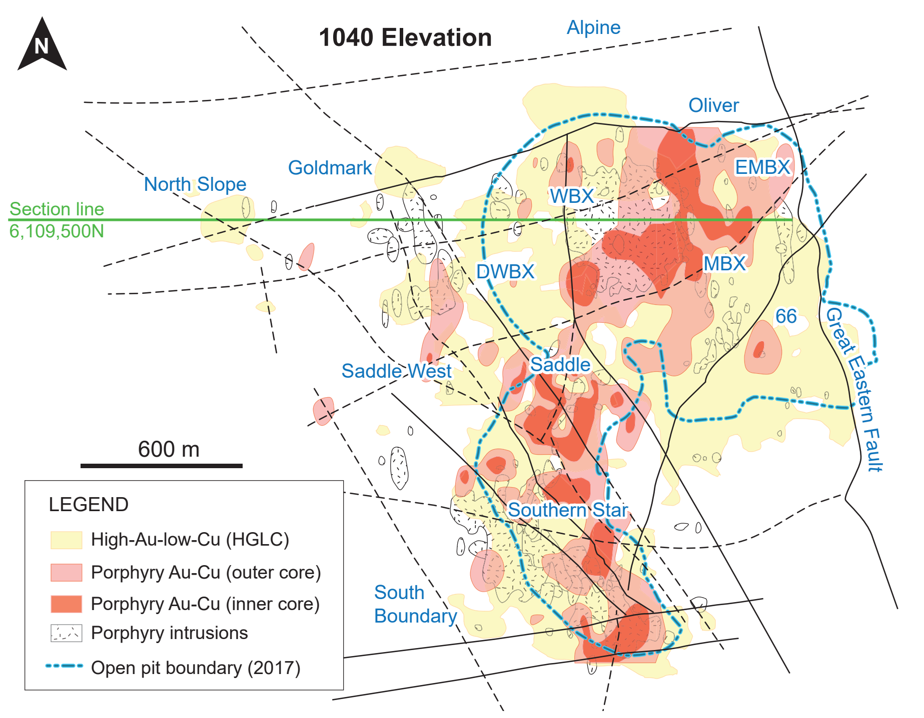

Figure 5. Plan view of the Mt. Milligan deposit, showing schematic distribution of early porphyry Au-Cu and late high-Au/low-Cu (HGLC) mineralization. The order of display in the image does not represent overprinting relationships; rather early porphyry intrusions are overprinted by porphyry Cu-Au mineralization, all of which is overprinted to varying degrees by late, HGLC mineralization. Simplified from Fitzgerald et al. (2020).

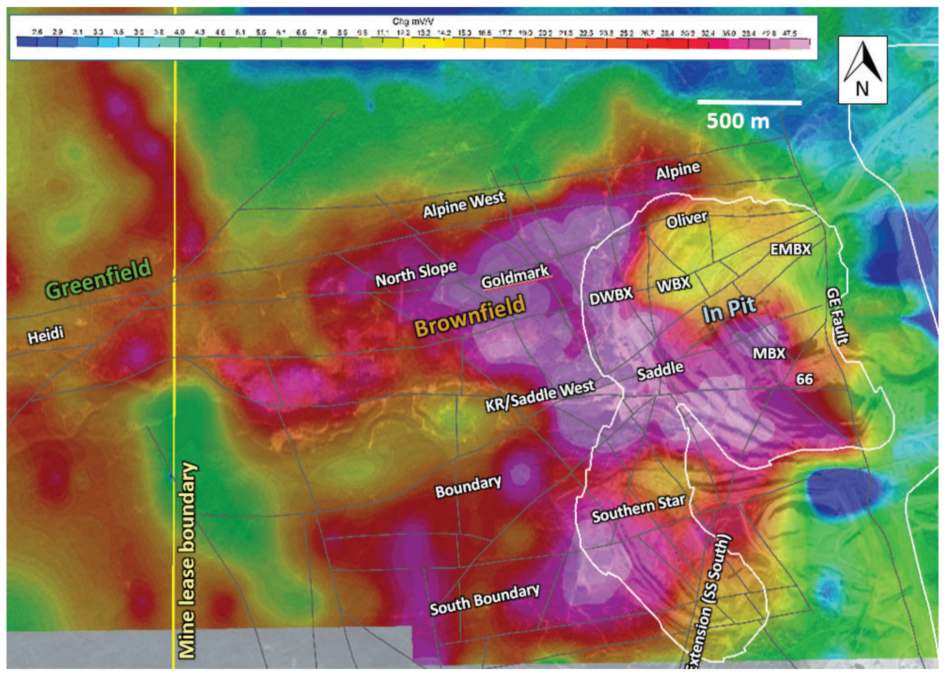

Figure 6. Map showing IP chargeability in the Mt. Milligan deposit area, including the names of exploration zones within the In Pit (NPI), Brownfields and Greenfields areas. White outline is the 2020 ultimate pit and TSF boundary. After Fitzgerald et al. (2020).

Potassic alteration is largely overprinted by younger assemblages outward from the stocks. Jago (2008) defined a progressively overprinting and outward developed zonation of potassic, out to sodic-calcic (albite-actinolite-epidote-pyrite), to inner propylitic (epidote-albite-calcite-actinolite-pyrite), and outer propylitic (epidote-chlorite-pyrite). A late, overprinting carbonate-phyllic alteration (quartz-sericite-pyrite-carbonate) is also recognized and is well developed along specific stratigraphic horizons and along major east-northeast and north-northwest trending faults (Jago et al., 2014; Fitzgerald et al., 2020).

Cu and Au grades increase upwards in the system from deeper parts of the potassic zone around MBX to the more shallow parts of the system, and the Cu/Au ratio decreases, from 0.16 to 0.32 wt % Cu and 0.2 to 0.71 g/t Au. Au values persist into outer alteration within the pyrite-dominant vein assemblages. There is a deposit-wide pyrite halo associated with peripheral sodic-calcic, inner and outer propylitic, and carbonate-phyllic assemblages: pyrite abundance is 1-5 modal % (Jago et al, 2014).

The Cu-Au mineralization associated with the potassic alteration is recognized as a separate and relatively earlier event than a later Au-mineralizing event that is associated with the carbonate-phyllic alteration. The Cu-Au mineralization includes chalcopyrite and pyrite associated with early-stage vein types and is spatially associated with potassic alteration and the porphyry stocks. The later Au-mineralization is a high-gold, low-copper mineralization (now refered to as HGLC) that is considered to represent a later, higher-level style of mineralization that is pyrite-dominant, high-gold, and structurally-controlled (Fitzgerald et al., 2020). The veins associated with the HGLC mineralization were investigated by LeFort et al. (2011) as being late stage quartz-pyrite-Au-PGE veins. The observation by Rebagliati (1988) of gold zones along structures also relates to the now-recognized HGLC late stage mineralization.

In the near surface, mineralization and hydrothermal features in coherent rocks are cut off to the east by the Great Eastern Fault, a north-striking, moderately east-dipping fault that juxtaposes the Mt. Milligan system with interpreted Early Tertiary volcanic and sedimentary rocks to the east. However, fault brecciated and comminuted rocks of the Mt. Milligan deposit form zones of mineralization within the Great Eastern Fault Zone itself. The system is open to the west and the persistence of a sulphide halo and polymetallic geochemistry broadly define the outer reaches of the hydrothermal system. With a strong pyrite halo, IP geophysics has been particularly successful in defining the hydrothermal limits and refining brownfields exploration targets (Fig. 6).

SUCCESSFUL EXPLORATION AT MT. MILLIGAN

The exploration program that ultimately led to the discovery of the Mt. Milligan deposit occurred over a period of under 5 years. The original exploration team from Selco (then BP Resources - Selco division) quickly recognized the importance of mineralization in the North Slope area and moved to expand their exploration program to an expanded land package. Prospecting and geological work, as well as an early, expansive soil survey program were instrumental in the identification of the size of the geochemical anomaly and the identification of numerous targets. These targets were quickly and successfully followed up on with ground-based geophysics and trenching, and then drilling. It was good mineral exploration guided by a geological understanding of what was being explored for.

Several regional surveys, including RGS, till and biogeochemistry surveys were completed in the region following the discovery of the Mt. Milligan deposit and around the time of renewed interest in the Nation Lakes region in the late 1980's and into the 1990s. These survey data are presented in this atlas and allow an evaluation of how regional data may be used to guide early prospecting efforts for similar deposits both nearby and in other regions.

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DATA AVAILABILITY

This Publication

The data layers presented in this publication are available in digital form as a GIS package available through the Geoscience BC website. Data for the Mt. Milligan area has been compiled from various public sources. In many cases original files for imagery, basemap data and geological mapping have not been modified: original linework is presented as originally published, although the presentation style of various features may be unique to this atlas. In other cases, for example with geochemical and geophysical data, new layers generated from the original data are presented, such as organized geochemical data files and maps, geophysical maps and mapping of interpreted structural features from aeromagnetic data. All data layers presented herein are provided in the compiled GIS package (Devine et al., 2021) available for download from the Geoscience BC website (https://www.geosciencebc.com/projects/2010-002/).

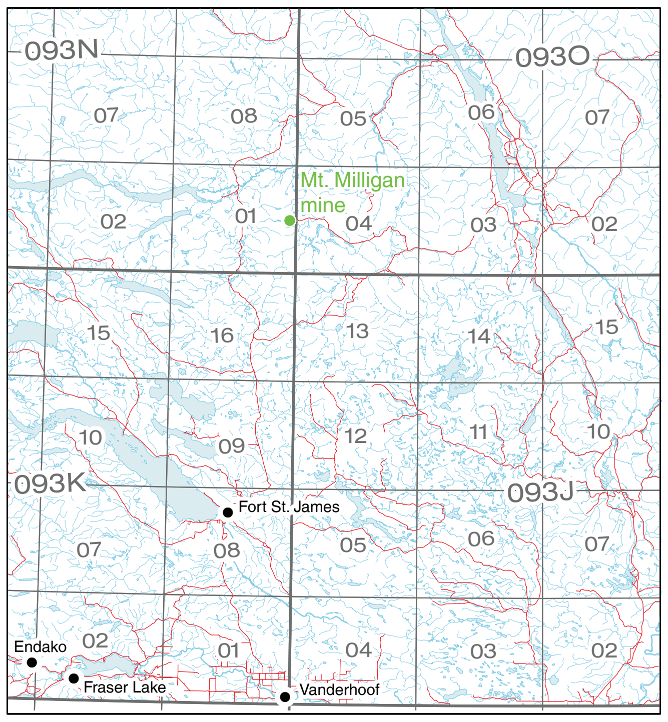

Figure 7. Map of the Nechako - southern Omenica region showing the location of the Mt. Milligan mine and the National Topographic system tiles that cover the area.

Digital Elevation Data

The Canadian Digital Elevation Data (CDED) is used in several maps within this atlas. It is delivered as 30 metre (1:50,000) and 90 metre (1:250,000) resolution digital elevation models. The data is delivered in tiles that correspond to eastern and western halves of the NTS tiles and is available through the GeoBase portal. The data is dervied from hypsographic and hydrographic elements within the National Topographic Data Base as well as other positional data.

The CDED is considered a legacy product, and users may now move to the up-to-date Canadian Digital Elevation Model (CDEM) product.

Natural Resources Canada (2000): Geobase - Canadian Digital Elevation Data; Natural Resources Canada, GeoBase®, downloads at geogratis.gc.ca. [May, 2021].

Mineral Occurrence Data

The BC Geological Survey maintains an inventory of geological, location and economic information on over 14,750 metallic, industrial mineral and coal mines, deposits, and occurrences in British Columbia. It is delivered publicly via the BC MINFILE database (URL <https://minfile.gov.bc.ca>). The database is active, with new occurrences being added through review of mineral assessment reports, recent publication, press releases, and company websites.

B.C. Geological Survey (2021): MINFILE BC mineral deposits database; B.C. Ministry of Energy, Mines and Petroleum Resouces, URL <https://minfile.gov.bc.ca> [May, 2021].

Imagery

For the Mt. Milligan area various image sources are available depending on ones zoom factor; ranging from Landsat to SPOT to air photos. The detailed imagery is from airborne sources rather than satellite.

One source of satellite imagery used in this atlas is the SPOT satellite imagery database. It is available for viewing and download through the Google Earth viewer. Copyright restrictions apply to Google Earth images for many end-user applications.

Topographic Data Layers

Topographic vector data from the National Topographic Data Base (NTDB) is available for download at no charge from Natural Resources Canada, Geomatics Canada through the GeoGratis portal. The maps within the National Topographic System (NTS) and are available in two standard scales: 1:250,000 and 1:50,000. The 1:50,000 series is available in a variety of raster and vector formats; the vector files are currently delivered as the CanVec product which conforms to international geomatics standards. The map tiles applicable to the Mt. Milligan region are shown in Figure 7.

NTDB 1:250,000 scale:

National Topographic Database, 1:250,000 tiles 093J,K,N,O, Natural Resources Canada, Geomatics Canada, 2021.
URL <http://geogratis.gc.ca/> [May, 2021]

CanVec 1:50,000 scale:

Natural Resources Canada (2012): CanVec, Canada, 093J,K,N,O; Natural Resources Canada, Earth Sciences Sector, Mapping Information Branch, Centre for Topographic Information, URL <http://geogratis.gc.ca> [May, 2021]

Roads

Additional vector files for road data are from the BC Digital Road Atlas, which is a collection of detailed road data for the Province. It is delivered through GeoBC, and may be found in the BC Data Catalogue, or downloaded directly here:

<https://www2.gov.bc.ca/gov/content/data/geographic-data-services/topographic-data/roads> [May, 2021]

Bedrock Geological Mapping

Bedrock geological maps are presented at three different scales over the Mt. Milligan area.

1:250,000 and 1:50,000 scale

The BC digital geology map is produced and maintained by the BC Geological Survey:

Cui, Y., Miller, D., Schiarizza, P., and Diakow, L.J., 2017. British Columbia digital geology. British Columbia Ministry of Energy, Mines and Petroleum Resources, British Columbia Geological Survey Open File 2017-8, 9p. Data version 2019-12-19.

For the area around Mt. Milligan, the geology is incoporated from the QUEST compilation:

Logan, J.M., Schiarizza, P., Struik, L.C., Barnett, C., Nelson, J.L., Kowalczyk, P., Ferri, F., Mihalynuk, M.G., Thomas, M.D., Gammon, P., Lett, R., Jackaman, W. and Ferbey, T., 2010: Bedrock Geology of the QUEST map area, central British Columbia; British Columbia Geological Survey Geoscience Map 2010-1, Geoscience BC Report 2010-5, and Geological Survey of Canada Open File 6476.

The QUEST compilation in the Nation Lakes region relied upon the regional mapping of Nelson and Bellefontaine (1996):

Nelson, J.L. and Bellefontaine, K.A. (1996): The geology and mineral deposits of north-central Quesnellia; Tezzeron Lake to Discovery Creek, central British Columbia; Bulletin 99, BC Geological Survey, pp116

1:20,000 scale:

Recent deposit-scale surface geology compilations released by Centerra Gold as part of their technical reporting on the Mt. Milligan deposit were compiled into a single map presented in this atlas.

Centerra Gold in:

Andrews, P., Berthelsen, D., Lipiec, I. (2017): Technical report on the Mount Milligan Mine north-central British Columbia; NI 43-101 report for Centerra Gold Inc., pp 238.

Fitzgerald, J., Jago, C.P., Jankovic, S., Simoniam, B., Taylor, C.A., Borntraeger, B. (2020): Technical report on the Mount Milligan Mine north-central British Columbia; NI 43-101 report for Centerra Gold Inc., pp268.

Some early mapping from assessment reports was also included:

Heberlein, D.R., Rebagliati, C.M., Hoffman, S.J. (1984): Assessment report on the 1984 geological and geochemical exploration activities Phil A, B, and 1 claim groups; BC Geological Survey Assessment Report 12912, pp. 271.

Surficial Geological Mapping

Surficial geological mapping for the Mt. Milligan area is from two sources:

Regional mapping by Kerr (1991):

Kerr, D.E. (1991): Surficial geology of the Mount Milligan Area; British Columbia Ministry of Energy, Mines and Petroleum Resources, Open File 1991-07, scale 1:50,000.

And deposit area mapping by Ricker (1991):

Ricker, K.E. (1991): A preliminary appraisal of the surficial geology of the Mt. Milligan mine site with special reference to tailings impoundment area "A"; Internal report prepared for Placer Dome Inc. Project Development.

Gravity Data

A new gravity survey was flown in 2008 in the central BC region, as part of the Geoscience BC QUEST project. The data for the survey are availalble from Geoscience BC:

Sander Geophysics Limited (2008): Airborne gravity survey, Quesnellia Region, British Columbia; Geoscience BC, Report 2008-8, 121 p., URL <http://www.geosciencebc.com/major-projects/quest/> [May, 2021]

Aeromagnetics

Geological Survey of Canada data sets used were downloaded from the Canadian Aeromagnetic database. The individual gridded data files were reprojected into NAD83 UTM Zone 10N prior to being combined together.

In addition, more detailed data for the majority of the Mt. Milligan region is from the Geoscience BC QUEST poroject VTEM data:

Geotech Limited, 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 & 94C, D); Geoscience BC, Report 2008-04.

Radiometrics

Gamma-ray spectrometric data was collected as part of the regional aeromagnetic surveys. It is included as part of the National Gamma-Ray Spectrometry Program Data Base or Natural Resources Canada.

Data from URL <http://gdr.agg.nrcan.gc.ca> (April, 2021)

Electromagnetics - VTEM

Time Domain Helicopter EM Data (V TEM) was released by Geoscience BC over the Quest area in 2008 (GBC project 2008-4). 1D conductivity soundings were inverted along the flight lines and presented as conductivity-depth sections; 1D inversion results released in 2009 (GBC project 2009-15).

Geotech Limited, 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 & 94C, D); Geosience BC Report 2008-4, report and data.

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, report and data.

Induced Polarization Surveys

While there have been no deposit-scale ground-magnetic maps nor induced polarization data shown in this atlas, both were important to the early identification of target zones at Mount Milligan. There are several vintages of surveys, including on-going work by Centerra in the deposit area (Fig. 6; Fitzgerald et al., 2020).

Mt. Milligan has been included in several studies that highlight the relationships of geology and geophysics of the deposit, for example in:

Mitchinson, D.E. and Enkin, R.J. (2011): Continued investigations of physical property–geology relationships in porphyry deposit settings in the QUEST and QUEST-West Project areas, central British Columbia (NTS 093E, K, L, M, N); in Geoscience BC Summary of Activities 2010, Geoscience BC, Report 2011-1, p. 17–32.

Mitchinson, D. E., Enkin, R.J., and Hart, C.J.R. (2013): Linking Porphyry Deposit Geology to Geophysics via Physical Properties: Adding Value to Geoscience BC Geophysical Data; Geoscience BC Report 2013-14, 116 pages.

Mitchinson, D.E., Hart, C.J.R. and Fournier, D. (2021): Uncovering porphyry-deposit potential in the Quesnel terrane of central British Columbia using geology and 3-D geophysics (parts of NTS 093A, B, G, H, J, K, O); in Geoscience BC Summary of Activities 2020: Minerals, Geoscience BC, Report 2021-01, p. 11–24.

Regional Stream Sediment Geochemistry

Regional stream sediment geochemistry used in this atlas is form the BC Geological Survey Regional Geochemical Survey program data. The version used is:

Rukhlov, A. and Naziri, M. (2015): Regional Geochemical Database 2015. British Columbia Ministry of Energy and Mines, British Columbia Geological Survey GeoFile 2015-03.

which includes:

Jackaman, W. (2008): QUEST Project sample reanalysis; Geoscience BC, Report 2008-3, 4 p.

Till Geochemistry

Till geochemistry data in the Mt. Milligan area is from:

Sibbick, S., Balma, R.G., Dunn, C.E. (1996): Till Geochemistry of the Mount Milligan Area (Parts of 93N/1 & 93O/4; British Columbia Ministry of Energy, Mines and Petroleum Resources, Open File 1996-22.

digital data:

Dunn, C.E., Balma, R.G., Sibbick, S.J. (1996): Distribution of 40 elements derived from pine bark at 134 sites (GSC OF 3290) and 29 elements derived from till at 108 sites (GSC OF 3291) near the Mount Milligan copper-gold deposit in central British Colmbia, *in* S.Williams, B. Ballantyne R. Balma, K. Bellefontaine, C. Dunn, F. Ferri, J. Grant, A. Plouffe, R. Shives, S. Sibbick, B. Struik (1996): Quesnel Trough: a digital suite of geoscience information; BCGSB Open File 1996-17.

Biogeochemistry

Biogeochemistry data in the Mt. Milligan region for lodgepole pine bark were published by Dunn et al. (1996) as a compilation of samples collected during three survey efforts in 1991 and 1995.

Dunn, C.E., Balma, R.G., Sibbick, S.J. (1996): Distribution of 40 elements derived from pine bark at 134 sites (GSC OF 3290) and 29 elements derived from till at 108 sites (GSC OF 3291) near the Mount Milligan copper-gold deposit in central British Colmbia, *in* S.Williams, B. Ballantyne R. Balma, K. Bellefontaine, C. Dunn, F. Ferri, J. Grant, A. Plouffe, R. Shives, S. Sibbick, B. Struik (1996): Quesnel Trough: a digital suite of geoscience information; BCGSB Open File 1996-17.

Soil Geochemistry

Pre-mining soil geochemistry data over the Mt. Milligan area is compiled from several different surveys completed under BP Resources Canada in 1984-1985. This is before clear-cut logging of a large part of the deposit area.

Several other more recent surveys (2010, 2011) published in assessment reports from outlying areas (eg. Mitzi Lake) have also been added to the compilation.

The reports with data included in the GBC compilation presented in this atlas are from:

Farmer and Rebagliati (1984): BC Geological Survey Assessment Report 11951.

Heberlein et al. (1984): BC Geological Survey Assessment Report 12912.

Heberlein (2010): BC Geological Survey Assessment Report 31930.

Leriche and Bower (1990): BC Geological Survey Assessment Report 20227.

Myers et al. (1985): BC Geological Survey Assessment Report 13891.

Myers and Rebagliati (1985): BC Geological Survey Assessment Report 14377.

Peters (2011): BC Geological Survey Assessment Report 32703.

Full references may be found in the reference list at the end of this document.

Mine area geochemical orientation survey

In 2005, Placer Dome geologists and consultants delivered the Mt. Milligan Geochemical Footprint Project, using bulk leach extracatable gold (BLEG), silt and water geochemistry to characterize the fluvial geochemical signature of the Mt. Milligan deposit.

Samples were collected at 31 sites within the deposit area and along King Richard and Rainbow creeks.

Lustig, G. and Fonseca, A. (2006): Mt. Milligan Project, Stream Sediment Geochemistry Survey; BC Geological Survey Assessment Report 28210, 148 pages.

Porphyry Districts of British Columbia Atlas Series

MT. MILLIGAN

A geo-exploration atlas of the Mt. Milligan porphyry copper-gold district

Geoscience BC

SATELLITE IMAGERY

1 : 250,000

Mt. Milligan orebodies

(Centerra 2017, *in* Andrews et al., 2017)

limit of
> 0.15 % Cu grade
1010 bench (metres a.s.l.)
(projected to surface)

SCALE 1 : 250,000

0 5 10 20

kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

Data Sources:

Google Earth
Imagery Date: 2013
Image © 2013 Province of British Columbia
© 2013 Google
© 2013 Cnes/Spot Image

Roads: British Columbia Digital Road Atlas, GeoBC URL < https://www2.gov.bc.ca/gov/content/data/geographic-data-services/topographic-data/roads> [May, 2021]

Hydrology: National Topographic Database, 1:250,000 tiles 093J,K,N,O, Natural Resources Canada, Geomatics Canada, 2021. URL <http://geogratis.gc.ca/> [May, 2021]

Porphyry Districts of British Columbia Atlas Series

MT. MILLIGAN

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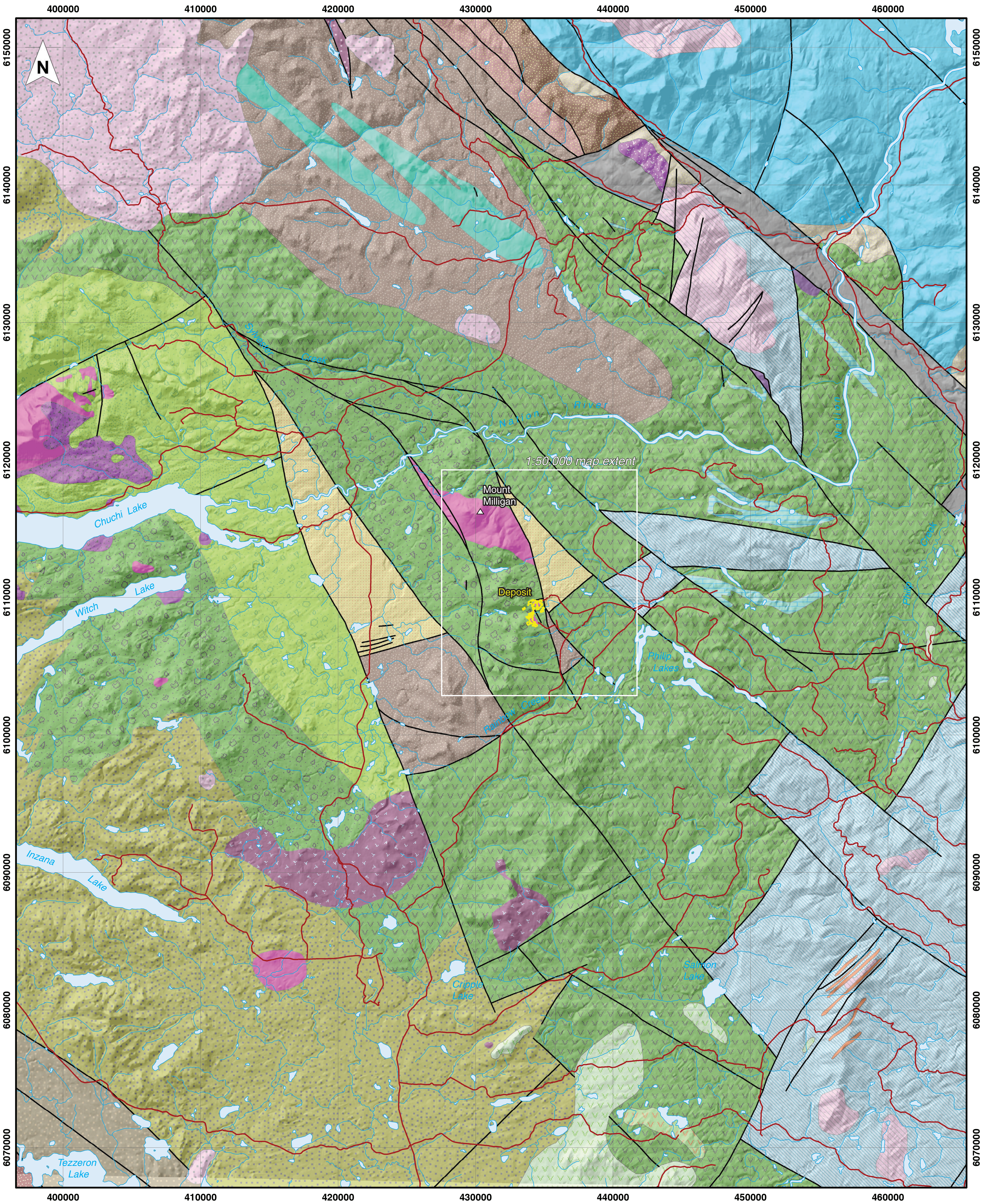
Geoscience BC

BEDROCK GEOLOGY

1 : 250,000



Overlap assemblages and postaccretionary rocks

MIOCENE

- MiPlCvb — Chilcotin Group: basalt

EOCENE - OLIGOCENE

- EOlEs — Nechako Plateau Group sedimentary rocks: Sandstone, mudstone, pebble conglomerate, volcanic wacke, volcanic ash and basalts

PALEOCENE - EOCENE

- PeEgr — Quartz feldspar porphyry granite plutons and dykes
- PeEvf — Rhyolite, felsic volcanic rocks

CRETACEOUS - TERTIARY

- KW — Wolverine Range plutonic suite: Foliated granodiorite, aegirine-augite monzodiorite and syenite, monzonite, alkaline syenite and pegmatite dikes

EARLY CRETACEOUS

- EKGm — Germansen Batholith: Granite, alkali geldspar granite
- KTgr — Undivided intrusive rocks: Granite, alkali feldspar granite

Triassic-Jurassic Quesnel terrane

EARLY JURASSIC (intrusive rocks)

- EJsy — Syenitic to monzonitic intrusions, including the Chuchi Syenite (EJHCsy)
- EJHqm — Hogem plutonic Suite: quartz monzonitic to monzogranitic intrusive rocks

LOWER JURASSIC (stratified rocks)

- lJC — Chuchi Lake Succession: Sub-aerial and sub-marine volcaniclastic and pyroclastic rocks

LATE TRIASSIC (Intrusive rocks)

- TrJsy — Syenitic to monzonitic intrusions
- TrJdr — Dioritic intrusive rocks
- LTrJum — Ultramafic rocks

MIDDLE - UPPER TRIASSIC (stratified rocks)

- uTrJTz — Tezzeron Sequence, sedimentary rocks: Argillite, greywacke, wacke, conglomerate turbidites

Takla Group

- uTrTl — Inzana Lake Formation, sedimentary rocks: Volcanic sandstone, siltstone, mudstone, argillite, andesite lapilli tuff
- uTrTls — Reefoid limestone, fossil-bearing
- uTrT — Calc-alkaline volcaniclastic rocks, incl. Witch Lake Formation (uTrTW): Dominated by volcanic flows, breccia and agglomerates
- TrJTvb / uTrTca — Calc-alkaline volcanic rocks, incl. Witch Lake Formation (uTrTWppbb): Augite-phyric and aphyric basalt breccia, agglomerate, tuff and flows.
- muTrTlm — Limestone, marble, calcareous sedimentary rocks
- muTrTsf — Sedimentary rocks: Mudstone, siltstone, shale, fine clastic rocks

Oceanic rocks

PALEOZOIC - MESOZOIC

- PJC — *Cache Creek Group:* mudstone, siltstone, shale fine clastic sedimentary rocks

Continental margin assemblages

PALEOZOIC

- MPM — Mason Lakes Ultramafics: serpentinite ultramafic rocks
- MPNH — Nina Creek Group: mudstone, shale, fine clastic rocks
- CPdr — Dioritic intrusive rocks
- DPBC — Big Creek Group: mudstone, siltstone, fine clastic rocks
- OMEsf — Earn Group: mudstone, siltstone, fine clastic rocks
- CmA — Atan Group: undivided limestone, quartzite, sandstone, shale

UPPER PROTEROZOIC

- uKEW — Wolverine Metamorphic Complex: Muscovite and biotite schist, paragneiss Neoproterozoic rocks with overprinting metamorphic–deformational event in the Middle to Late Jurassic or earlier. Record predominantly Late Jurassic to Early Cretaceous uplift of the complex, with Eocene resetting.
- uPrpg — North American basinal strata: paragneiss metamorphic rocks

SCALE 1 : 250,000

0 5 10 20

kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

Symbols

- roads
- fault
- geological contact

Data Sources:

Compilation map:

Logan, J.M., Schiarizza, P., Struik, L.C., Barnett, C., Nelson, J.L., Kowalczyk, P., Ferri, F., Mihalynuk, M.G., Thomas, M.D., Gammon, P., Lett, R., Jackaman, W. and Ferbey, T., 2010: Bedrock Geology of the QUEST map area, central British Columbia; British Columbia Geological Survey Geoscience Map 2010-1, Geoscience BC Report 2010-5, and Geological Survey of Canada Open File 6476.

Digital files of above publication are included in:

Cui, Y., Miller, D., Schiarizza, P., and Diakow, L.J., 2017. British Columbia digital geology. British Columbia Ministry of Energy, Mines and Petroleum Resources, British Columbia Geological Survey Open File 2017-8, 9p. Data version 2019-12-19.

Original mapping:

Nelson, J.L. and Bellefontaine, K.A. (1996): The geology and mineral deposits of north-central Quesnellia; Tezzeron Lake to Discovery Creek, central British Columbia; Bulletin 99, BC Geological Survey, 116 p.

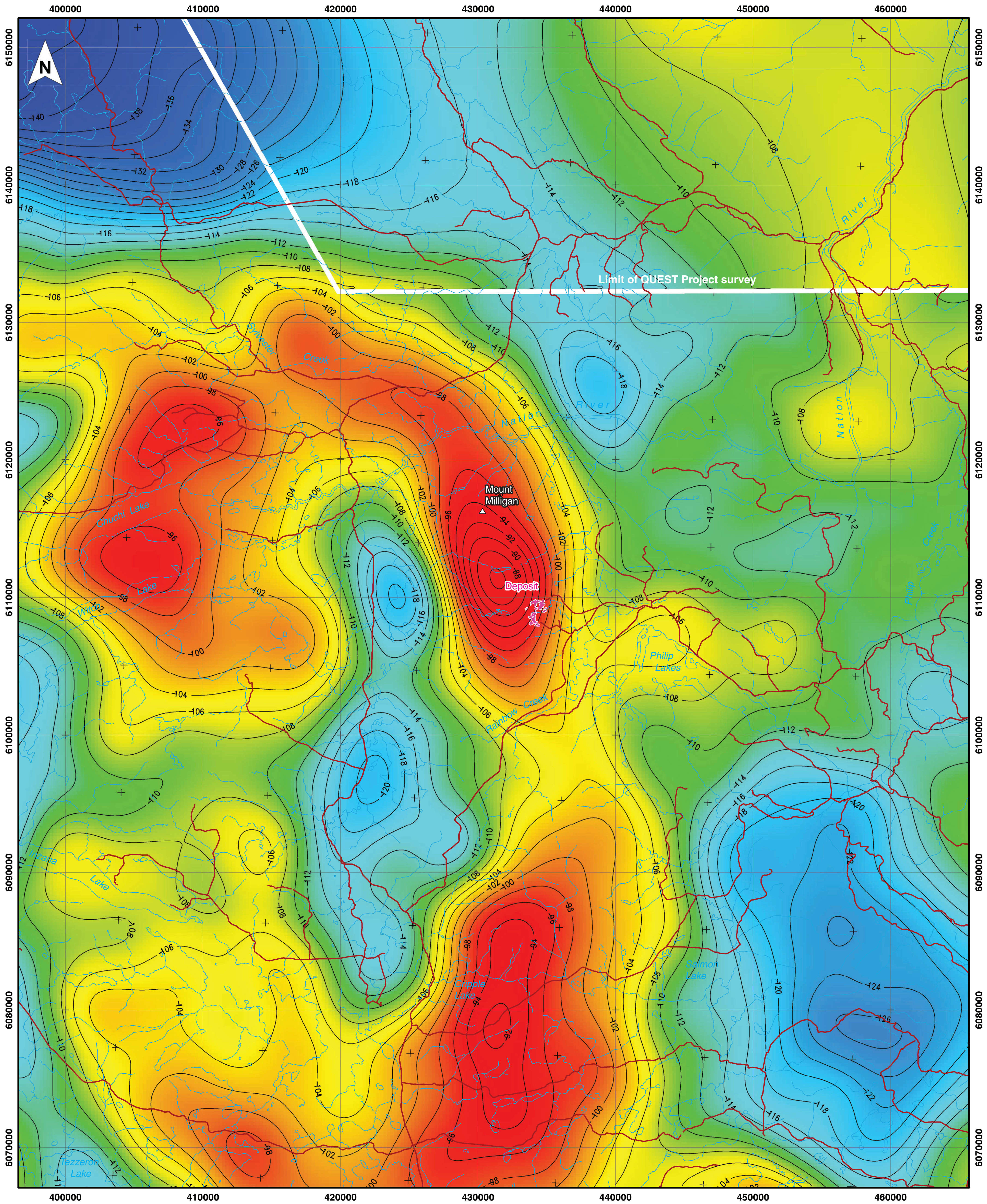
Porphyry Districts of British Columbia Atlas Series

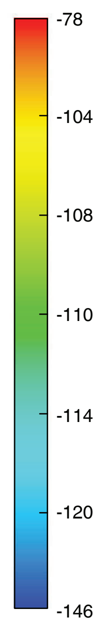
MT. MILLIGAN

A geo-exploration atlas of the Mt. Milligan porphyry copper-gold district

GRAVITY - BOUGER

1 : 250,000





Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)

limit of
> 0.15 % Cu grade
1010 bench (metres a.s.l.)
(projected to surface)

SCALE 1 : 250,000

0 5 10 20
kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

Data Sources:

Geoscience BC QUEST gravity data

Sander Geophysics Limited (2008): Airborne gravity survey, Quesnellia Region, British Columbia; Geoscience BC, Report 2008-08, 121 p.

Data over Mt. Milligan is from the Geoscience BC QUEST project.

Lower resolution data in the NE and SW corners is from the NRCAN national geophysical data repository.

The QUEST Data was processed using a Bouger Density of 4.5g/cm^3

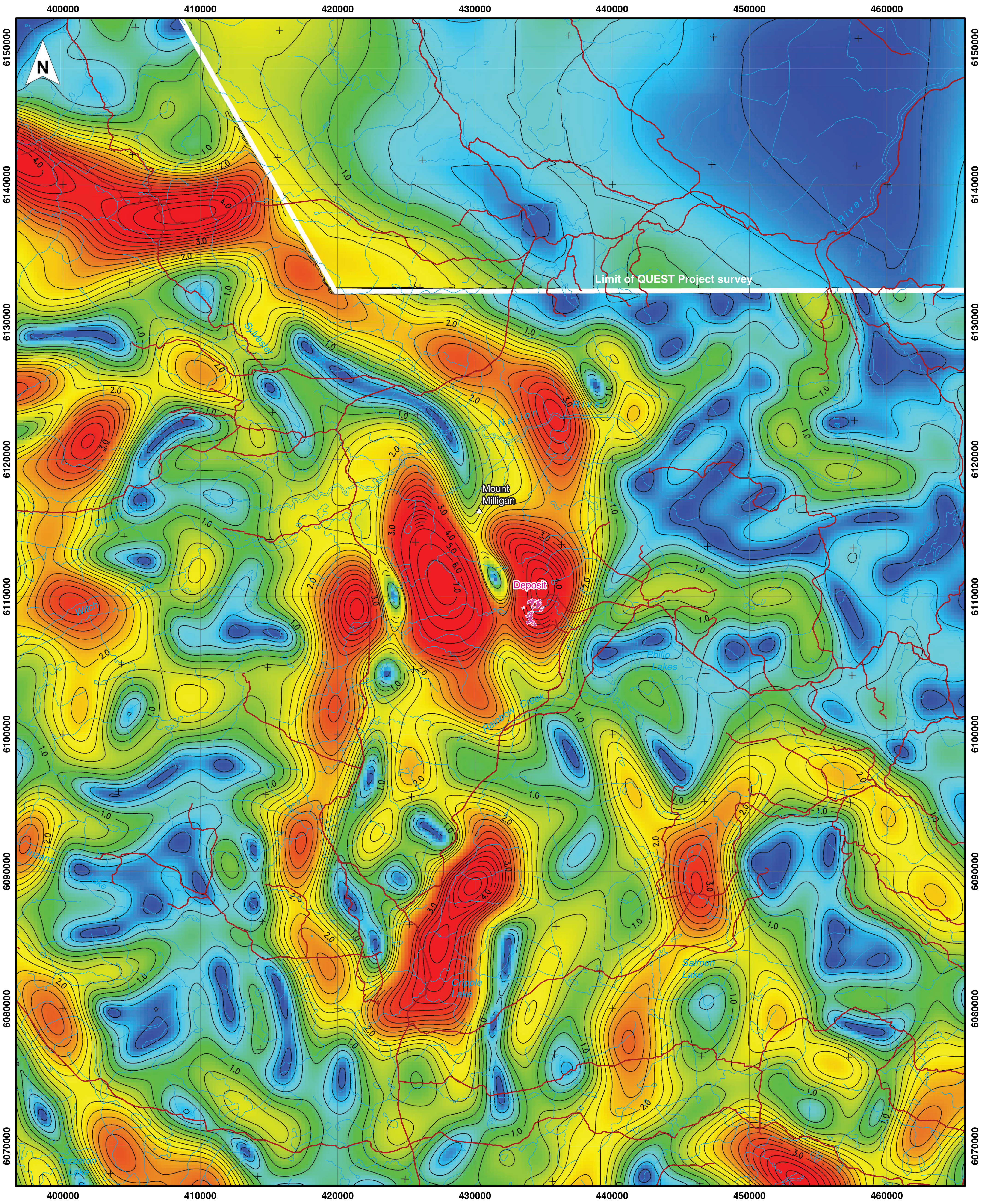
MT. MILLIGAN

A geo-exploration atlas of the Mt. Milligan porphyry copper-gold district

Geoscience BC

GRAVITY - BOUGER Horizontal Gradient

1 : 250,000



8
2
1
1
1
0
0

mgal / km

Mt. Milligan orebodies

(Centerra 2017, *in* Andrews et al., 2017)

limit of
> 0.15 % Cu grade
1010 bench (metres a.s.l.
(projected to surface)

SCALE 1 : 250,000

0 5 10 20

kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

Data Sources:

Geoscience BC QUEST gravity data

Sander Geophysics Limited (2008): Airborne gravity survey, Quesnellia Region, British Columbia; Geoscience BC, Report 2008-08, 121 p.

Data over Mt. Milligan is from the Geoscience BC QUEST project.

Lower resolution data in the NE and SW corners is from the NRCAN national geophysical data repository.

The QUEST Data was processed using a Bouger Density of 4.5g/cm^3

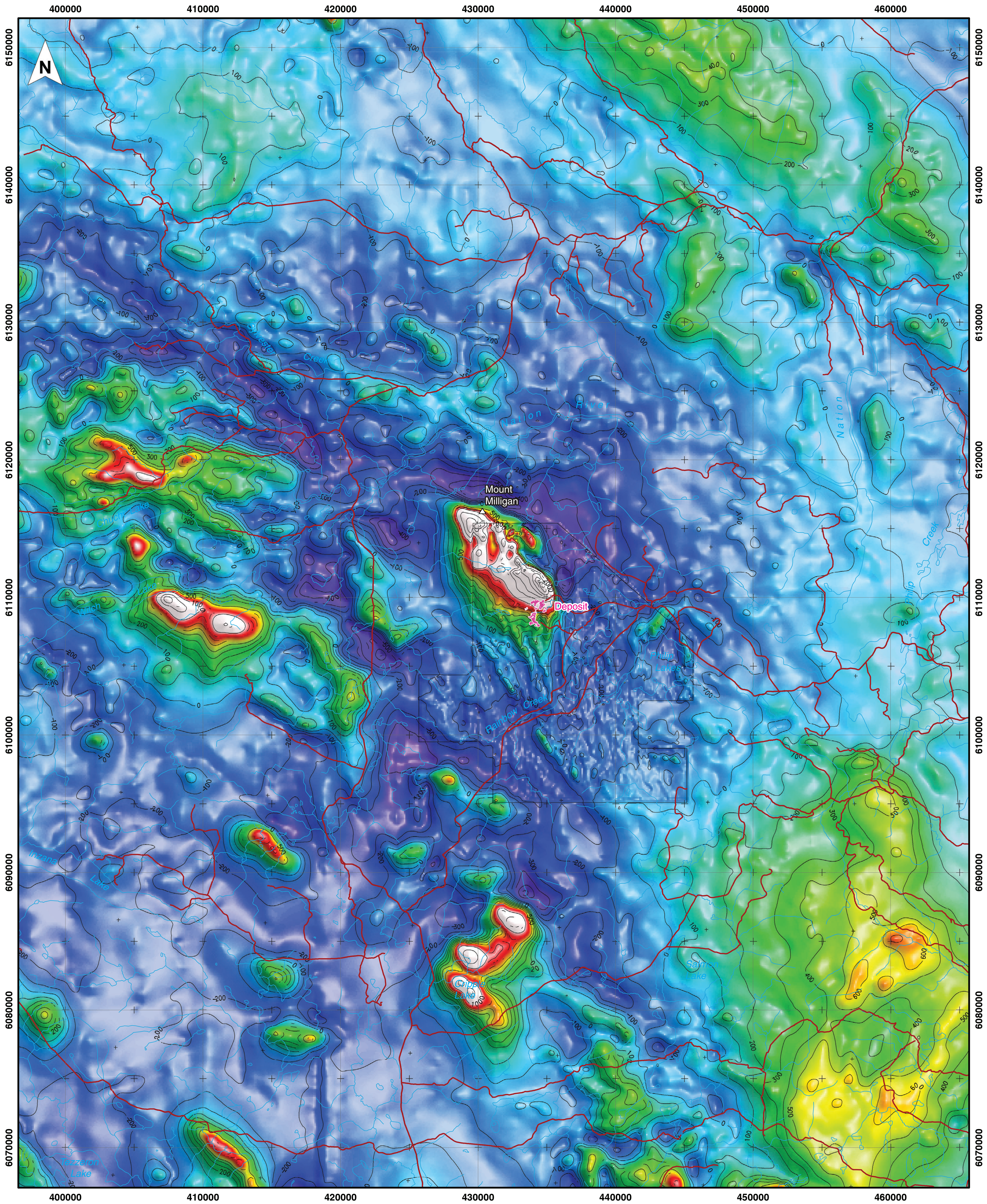
Units of the Horizontal Gradient are mgal/km.

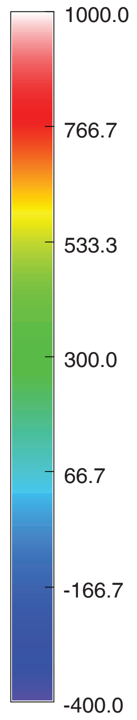
MT. MILLIGAN

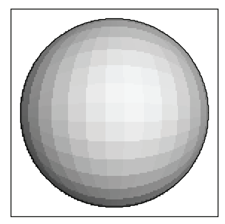
A geo-exploration atlas of the Mt. Milligan porphyry copper-gold district

Geoscience BC

MAGNETICS
Residual Magnetic Intensity
1 : 250,000







Azimuth : 45
Inclination : 75

Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)

limit of
> 0.15 % Cu grade
1010 bench (metres a.s.l.)
(projected to surface)

SCALE 1 : 250,000

0 5 10 20
kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

Data Sources:

Data from http://gdr.agg.nrcan.gc.ca
Geological Survey of Canada data set used was downloaded from the Canadian Aeromagnetic database.

2008 VTEM survey:
Geotech Limited, 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 & 94C, D); Geoscience BC, Report 2008-04.

Data has been merged and adjusted to a Residual Magnetic Intensity value using the NRCAN national 200m grid.

Data range -1210 nT to 4662 nT.

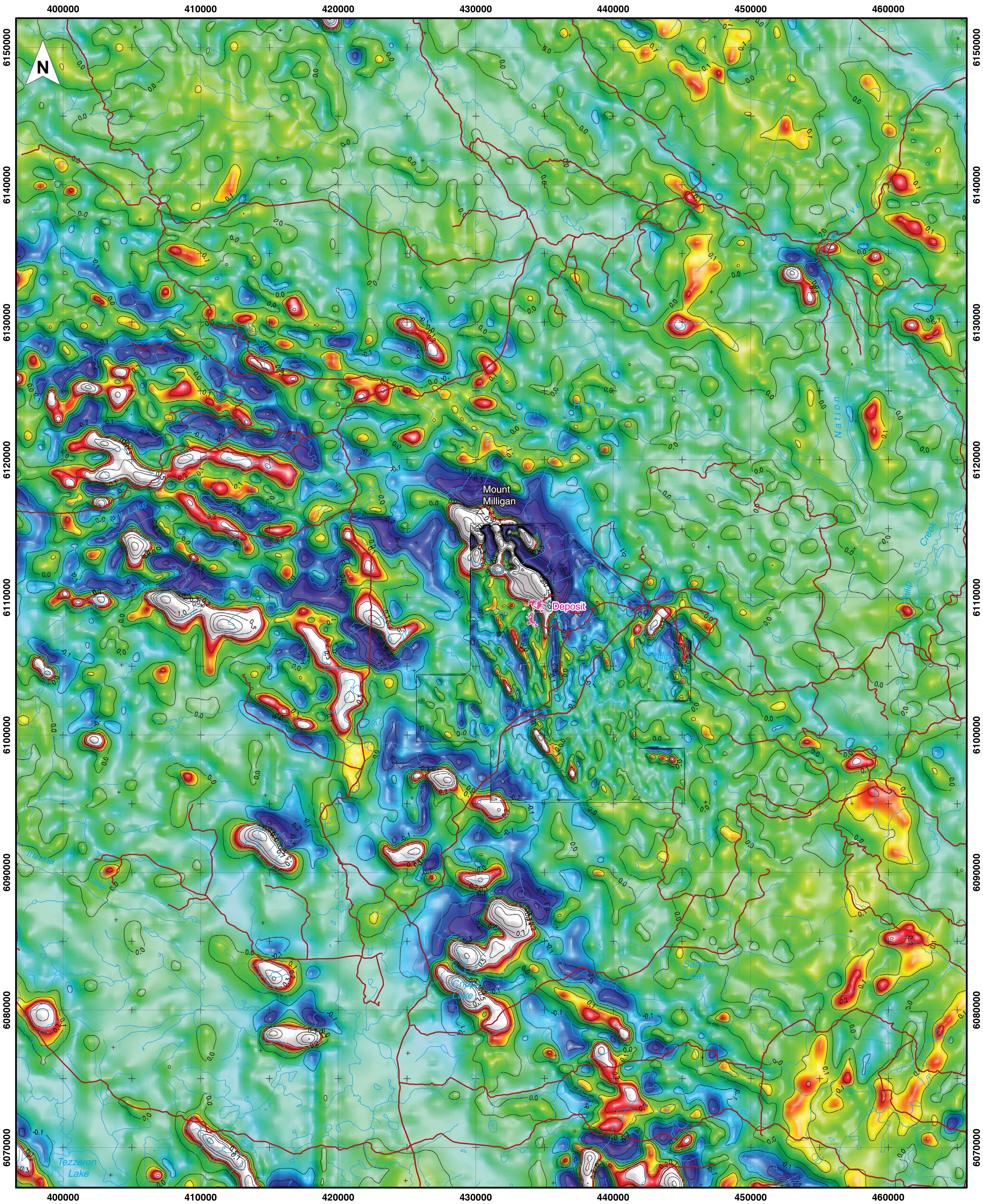
Porphyry Districts of British Columbia Atlas Series

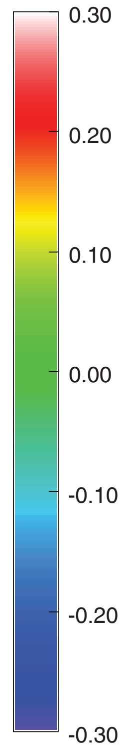
MT. MILLIGAN

A geo-exploration atlas of the Mt. Milligan porphyry copper-gold district

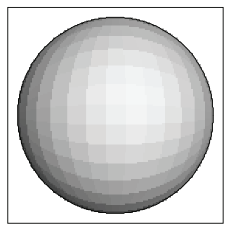
Geoscience BC

MAGNETICS
First Vertical Derivative
1 : 250,000





1VD (nT/m)

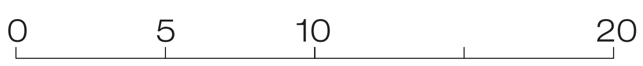


Azimuth : 45
Inclination : 75

Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)

limit of
> 0.15 % Cu grade
1010 bench (metres a.s.l.)
(projected to surface)

SCALE 1 : 250,000



kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

Data Sources:

Data from http://gdr.agg.nrcan.gc.ca
Geological Survey of Canada data set used was downloaded from the Canadian Aeromagnetic database.

2008 VTEM survey:
Geotech Limited, 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 & 94C, D); Geoscience BC, Report 2008-04.

1VD calculated and then upward continued 200m before merging with NRCAN data.

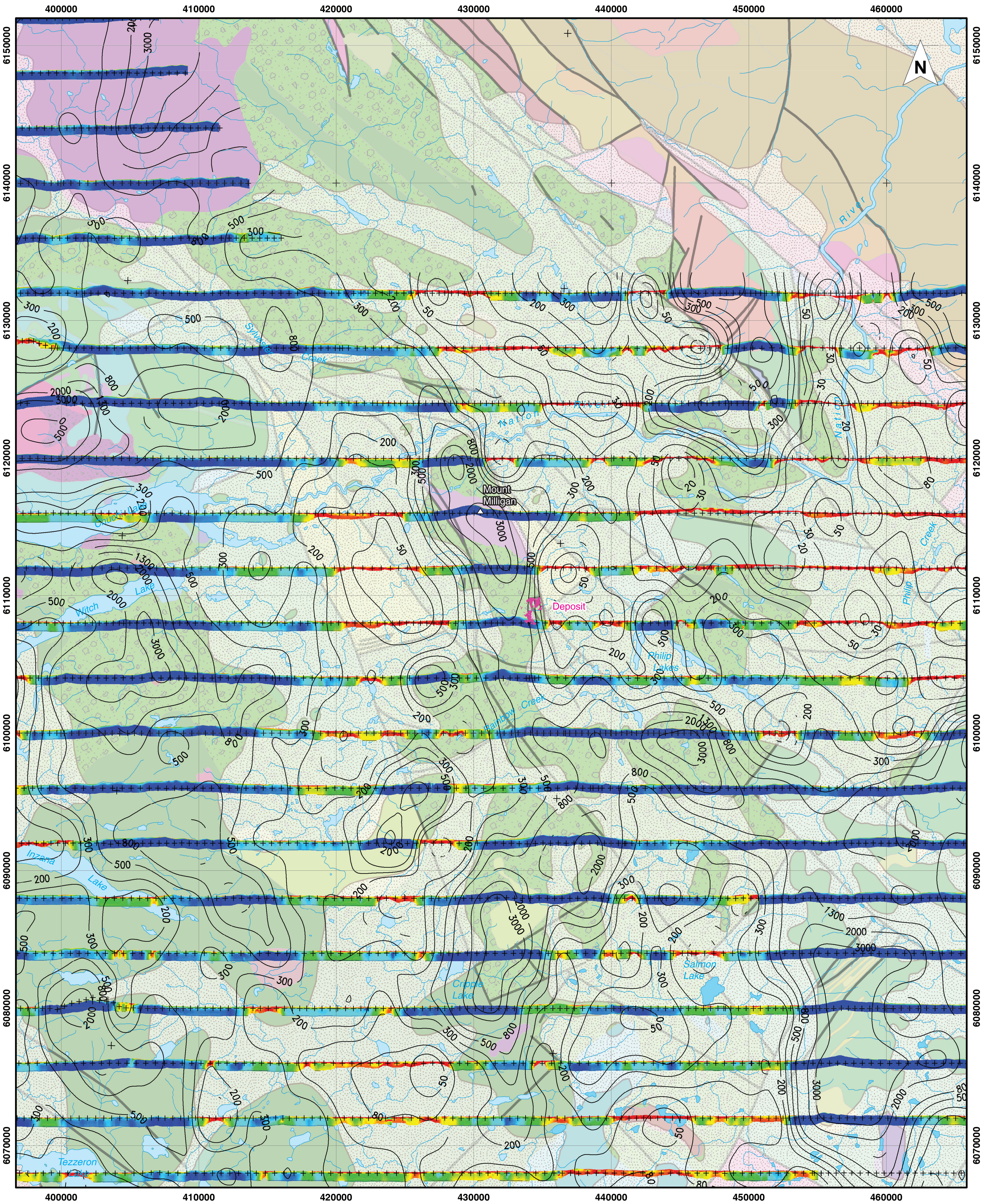
Data range -1.51nT/m to 5.93nT/m.

MT. MILLIGAN

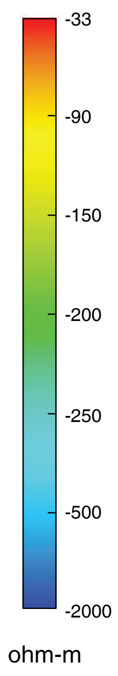
A geo-exploration atlas of the Mt. Milligan porphyry copper-gold district

Geoscience BC

VTEM
First Vertical Derivative Inversion
1 : 250,000



1D resistivity sections, with surficial cover over bedrock geology in the background



Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)

limit of
> 0.15 % Cu grade
1010 bench (metres a.s.l.)
(projected to surface)

SCALE 1 : 250,000

0 5 10 20
kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

Data Sources:

Phillips, N., Nguyen, T.N.H. and Thompson, V., 2009: QUEST Project: 3D inversion modelling, inegration, and visualization of airborne gravity, magnetic, and electromagnetic data, BC, Canada; Geoscience BC Report 2009-15, 87 pages and digital data, URL <http://www.geosciencebc.com/projects/2008-009/> May, 2021.

The 1D resistivity sections shown on this map were produced using the UBC-GIF program EM1DTM. The depth of investigation has been cut off when the total conductance of the inverted section exceeds 6 Siemens as the results are unreliable below this depth. Measurements along the flight line have been averaged over about 60m and then inverted as a single 1D sounding. 1D soundings have been stitched together along the flight line to produce the inverted section. This does not correspond exactly to a geology section and geometric artifacts may exist, for example conductive features may report to adjoining parts of the stitched section.

The contours are representative of values of bedrock or deep overburden, taken using a plan slice though a resistivity model made with 500m x 500m nodes interpolated between the flight lines from the higher resolution inversion results along lines. For additional information refer to the GBC report 2009-15.

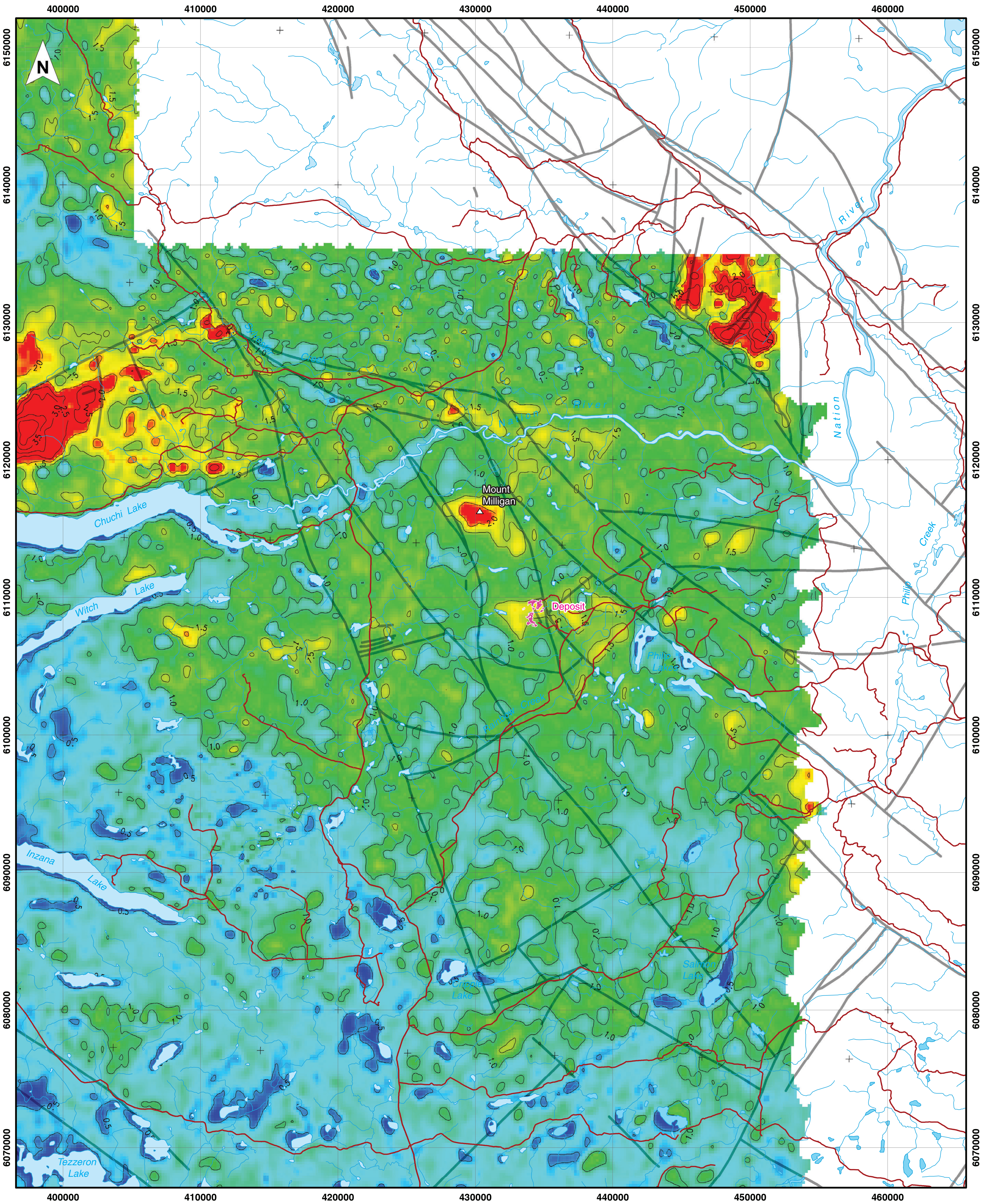
Note that ground resistivity of competent unbroken rock is generally high. Overburden, clays, and broken rock associated with faults or breccia zones may be reflected as regions of reduced resisitivity. Regions of alteration may produce low or intermediate resistivity responses. Sulfide mineralizaton or graphitic rocks may have low resistivity. Deeper parts of the inverted section are more likely to be a bedrock response, while the shallow parts are likely to show the response of the overburden if it exists.

MT. MILLIGAN

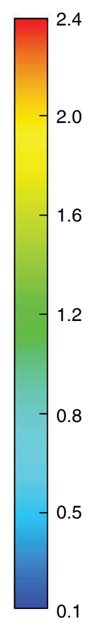
A geo-exploration atlas of the Mt. Milligan porphyry copper-gold district

Geoscience BC

RADIOMETRICS
% Potassium
1 : 250,000



Background of regional bedrock geology faults from BC Digital Geology map (2019-12)



% Potassium

Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)

limit of
> 0.15 % Cu grade
1010 bench (metres a.s.l.)
(projected to surface)

SCALE 1 : 250,000

0 5 10 20
kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

Data Sources:

Data from http://gdr.agg.nrcan.gc.ca
These data may be readily used for commercial, personal and public use and may be reproduced, in part or in whole and by any means, without charge for further permission from Natural Resources Canada.

These terms and conditions remain with the data at all times.

Radioactivity Data
Citation 2017:
National Gamma-Ray Spectrometry Program Data Base
Airborne Geophysics Section, GSC - Central Canada Division
Geological Survey of Canada, Earth Sciences Sector
Natural Resources Canada

This map:
Data from the NRCAN National Geophysical Database
Radiometrics National 250m grid.
% Potassium, data maximum 4.4% K

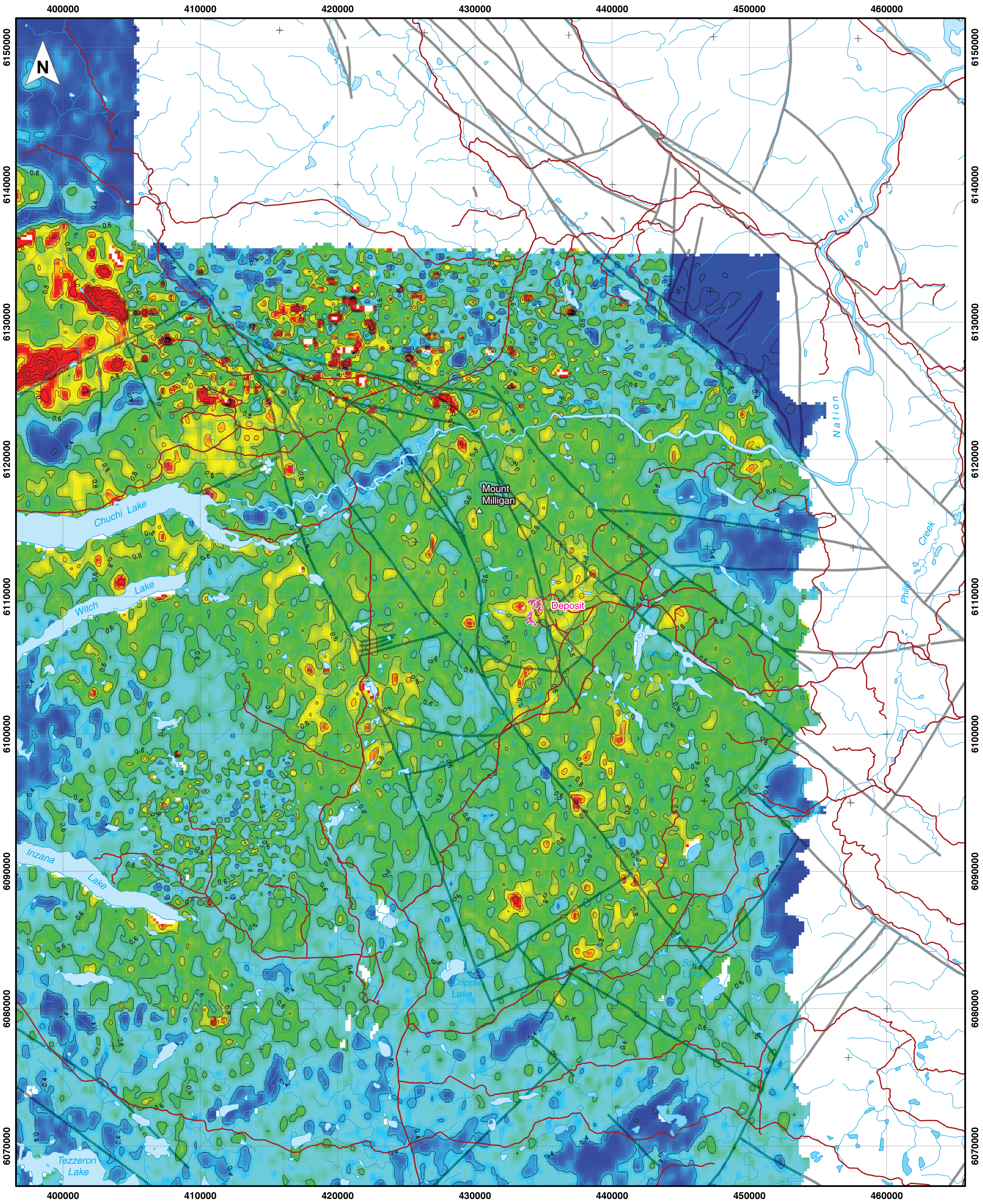
Porphyry Districts of British Columbia Atlas Series

MT. MILLIGAN

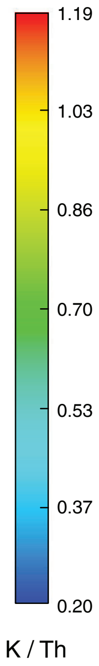
A geo-exploration atlas of the Mt. Milligan porphyry copper-gold district

Geoscience BC

RADIOMETRICS
K / eTh
1 : 250,000



Background of regional bedrock geology faults from BC Digital Geology map (2019-12)



Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)

limit of
> 0.15 % Cu grade
1010 bench (metres a.s.l.)
(projected to surface)

SCALE 1 : 250,000

0 5 10 20
kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

Data Sources:

Data from http://gdr.agg.nrcan.gc.ca
These data may be readily used for commercial, personal and public use and may be reproduced, in part or in whole and by any means, without charge for further permission from Natural Resources Canada.

These terms and conditions remain with the data at all times.

Radioactivity Data
Citation 2017:
National Gamma-Ray Spectrometry Program Data Base
Airborne Geophysics Section, GSC - Central Canada Division
Geological Survey of Canada, Earth Sciences Sector
Natural Resources Canada

This map:

Data from the NRCAN National Geophysical Database, Radiometrics National 250m grid.

The displayed ratio is computed as (% potassium) / (ppm thorium)

Note that both potassium and thorium quantities are subject to statistical uncertainty as radiometric assays are subject to a measurement error that increases at low values. A null value is presented herewhen the thorium radiometric estimate is less than 0.5 ppm Th.

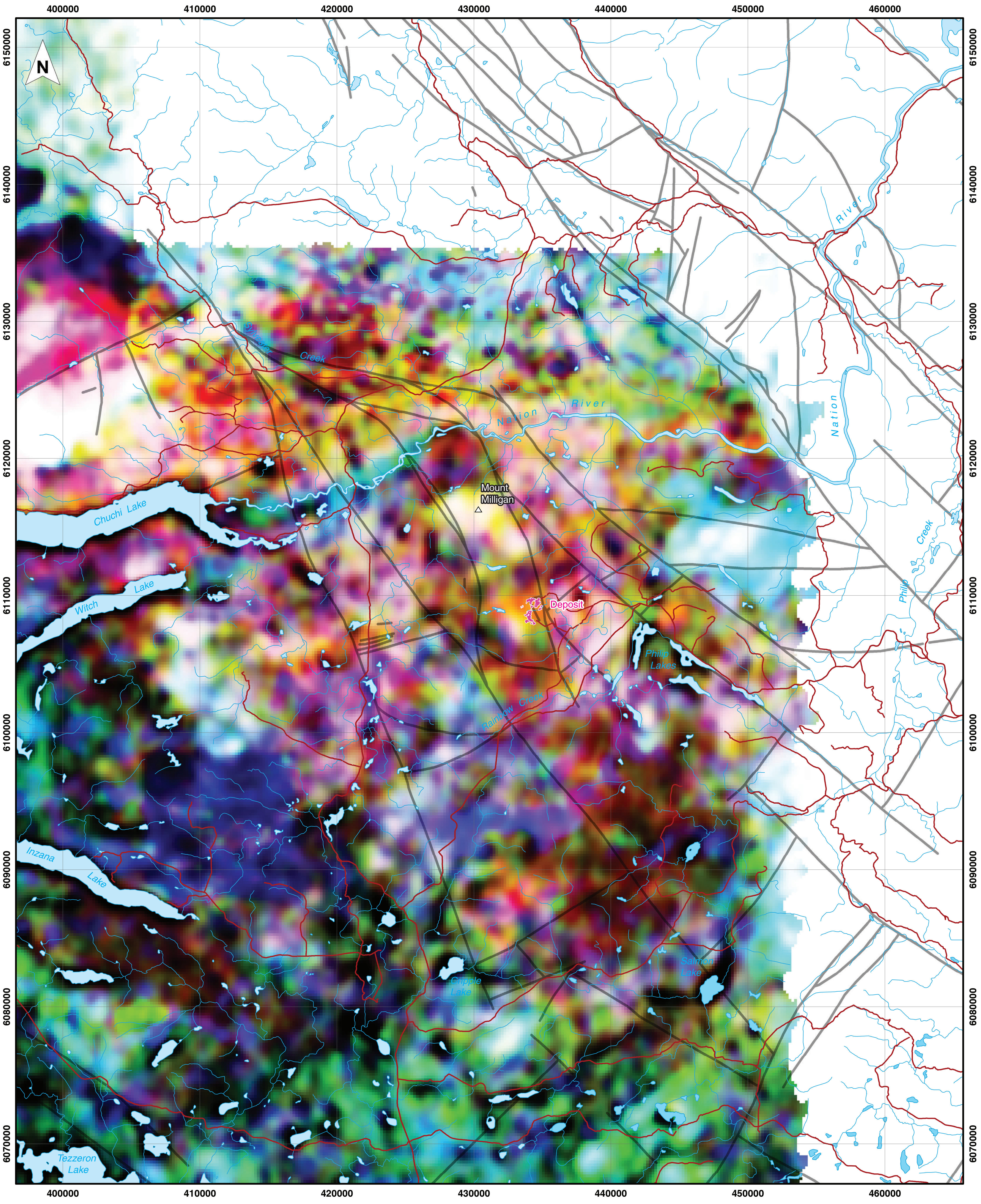
The computed ratio will increase either when the thorium value decreases or the potassium value increases.

MT. MILLIGAN

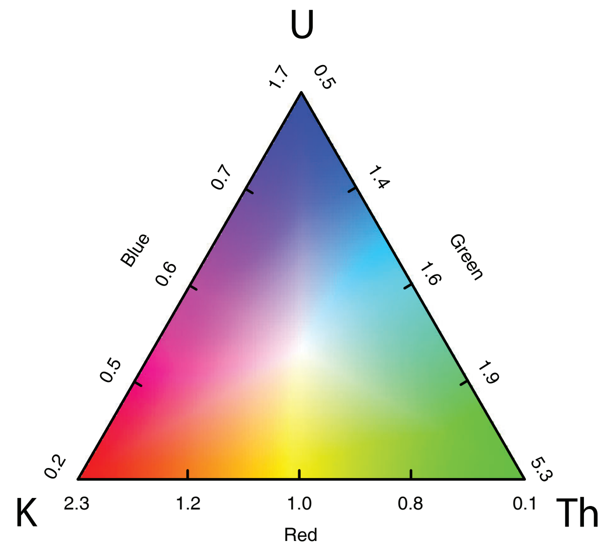
A geo-exploration atlas of the Mt. Milligan porphyry copper-gold district

Geoscience BC

RADIOMETRICS
KTU / RGB
1 : 250,000



Background of regional bedrock geology faults from BC Digital Geology map (2019-12)



Red : Combined Percent Potassium
Green : Combined Equivalent Thorium
Blue : Combined Equivalent Uranium

Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)

limit of
> 0.15 % Cu grade
1010 bench (metres a.s.l.)
(projected to surface)

SCALE 1 : 250,000

0 5 10 20
kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

Data Sources:

Data from http://gdr.agg.nrcan.gc.ca
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Radioactivity Data
Citation 2017:
National Gamma-Ray Spectrometry Program Data Base
Airborne Geophysics Section, GSC - Central Canada Division
Geological Survey of Canada, Earth Sciences Sector
Natural Resources Canada

NRCAN National Geophysical Database, Radiometrics National 250m grid.

The display image combines the potassium, thorium, uranium data using the red green blue image channels.

Red areas are enriched in potassium in relation to thorium and uranium.

Green areas are enriched in thorium in relation to potassium and uranium.

Blue areas are enriched in uranium in relation to potassium and thorium.

Note that radiometric assays are subject to statistical uncertainty and small calibration errors may give areas from different surveys slightly different hues.

The colour hue is a function of the ratios of the colours, the colour brightness is a function of the amount of each element per the radio-assay.

Porphyry Districts of British Columbia Atlas Series

MT. MILLIGAN

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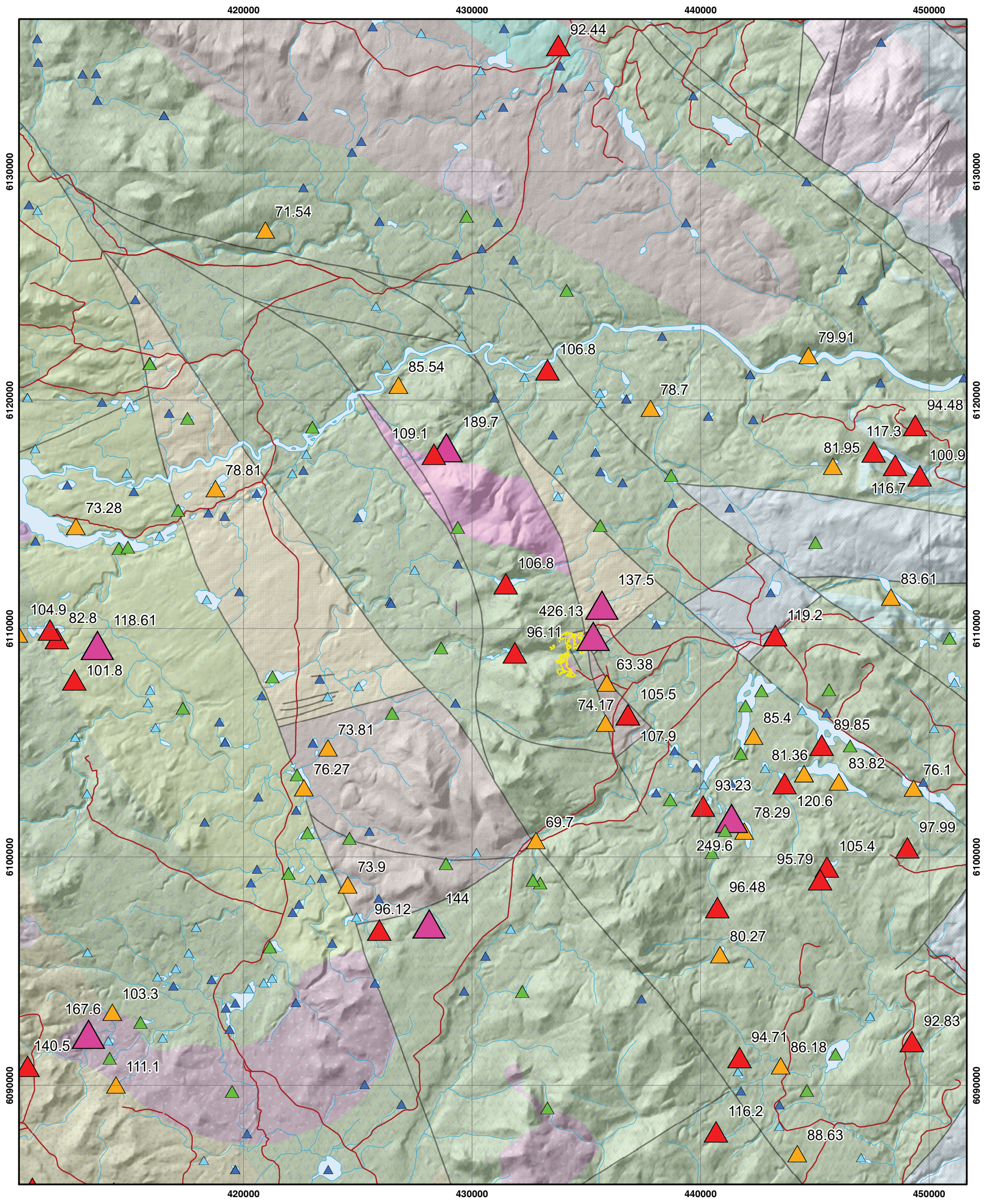
Geoscience BC

STREAM SEDIMENT GEOCHEMISTRY
Commodity Elements

1 : 300,000

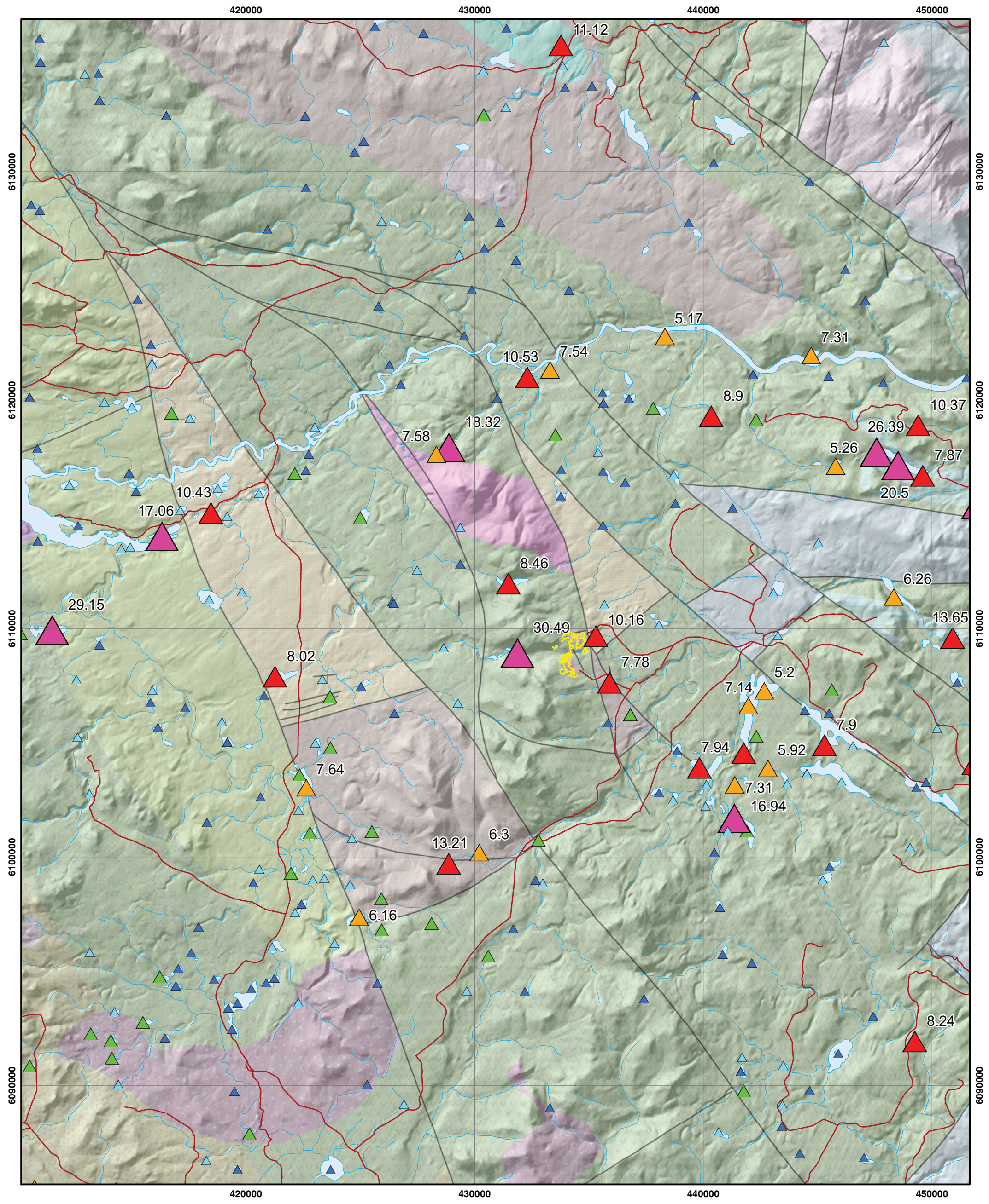


Cu

Stream Sediment

ppm (levelled)

- 0.0 - 40.5
- 40.6 - 56.9
- 57.0 - 74.2
- 74.3 - 90.5
- 90.6 - 123.3
- 123.4 - 507.4



Mo

Stream Sediment

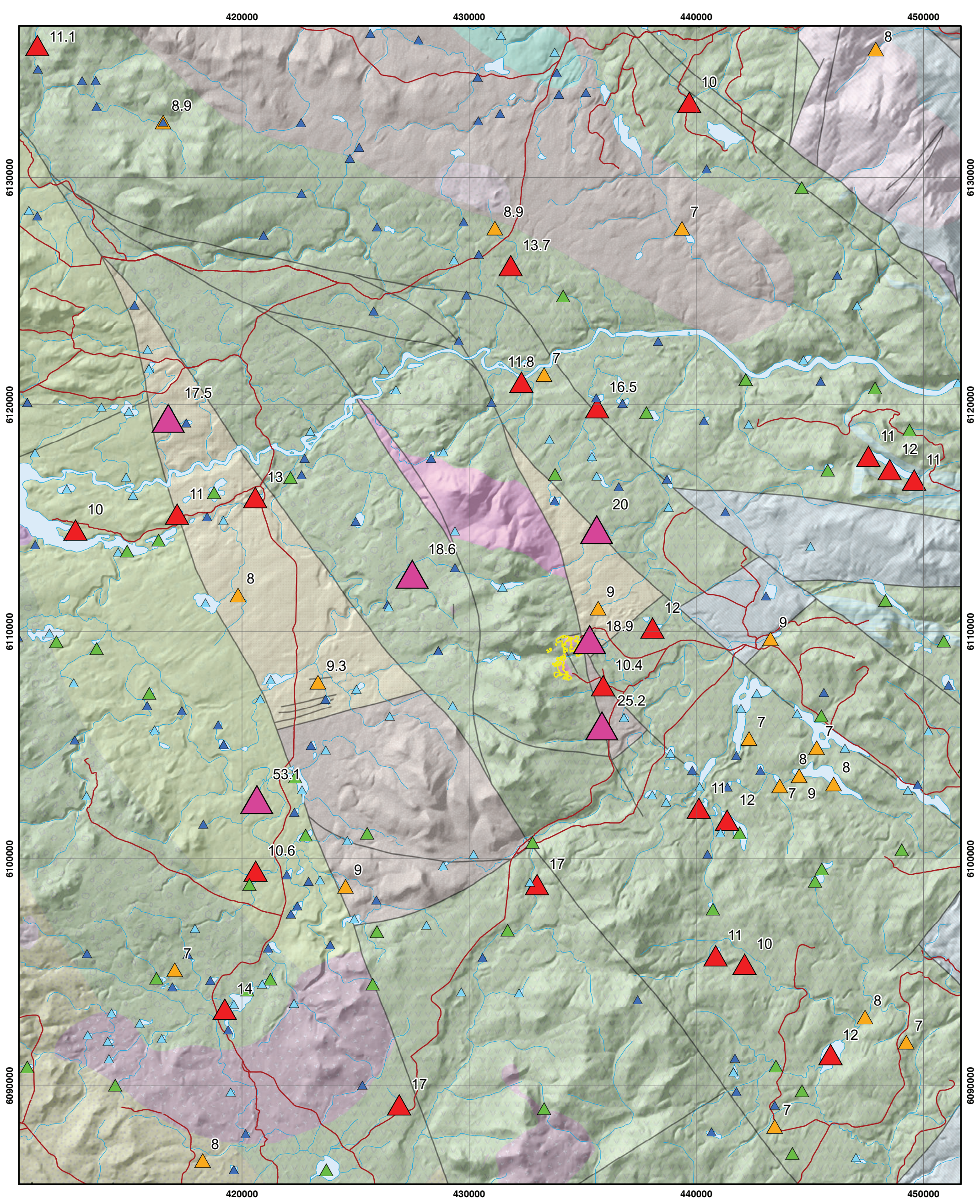
ppm (levelled)

- 0.0 - 1.89
- 1.90 - 3.40
- 3.41 - 5.15
- 5.16 - 7.77
- 7.78 - 16.15
- 16.16 - 30.54

Mt. Milligan orebodies

(Centerra 2017, *in* Andrews et al., 2017)

limit of > 0.15 % Cu grade 1010 bench (metres a.s.l.) (projected to surface)

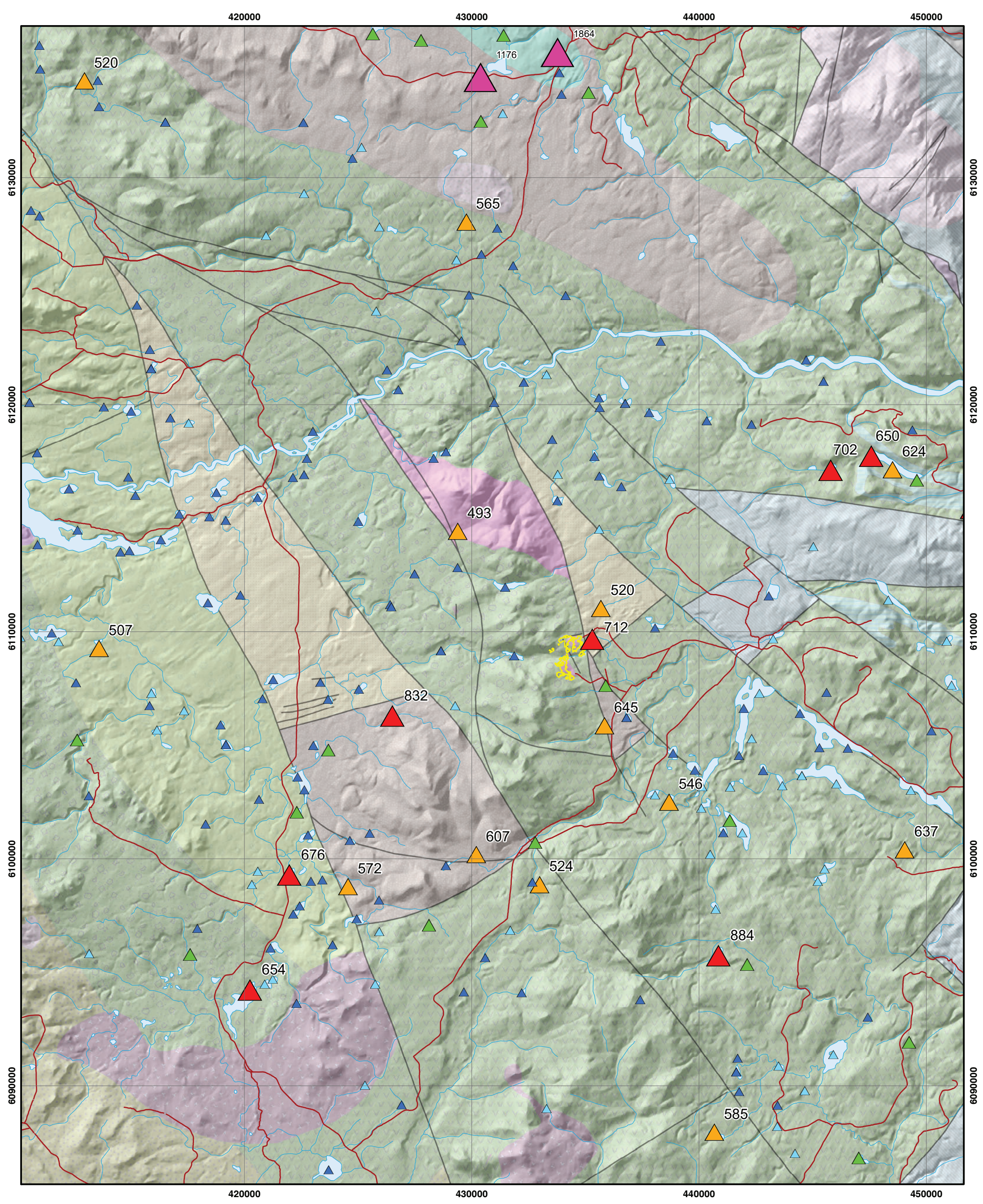


Au

Stream Sediment

ppb (levelled)

- 0.1 - 2.9
- 3.0 - 4.9
- 5.0 - 6.7
- 6.8 - 9.3
- 9.4 - 17.0
- 17.1 - 66.8



Ag

Stream Sediment

ppb (levelled)

- 0 - 258
- 259 - 379
- 380 - 493
- 494 - 649
- 650 - 961
- 962 - 2738

Data Sources:

Rukhlov, A. and Naziri, M. (2015): Regional Geochemical Database 2015. British Columbia Ministry of Energy and Mines, British Columbia Geological Survey GeoFile 2015-03.

Including:

Jackaman, W. (2008): QUEST Project sample reanalysis; Geoscience BC, Report 2008-03, 4 p.

SCALE 1 : 300,000

0 10 20

kilometres

Universal Transverse Mercator Projection

NAD 83 Datum, Zone 10

MT. MILLIGAN

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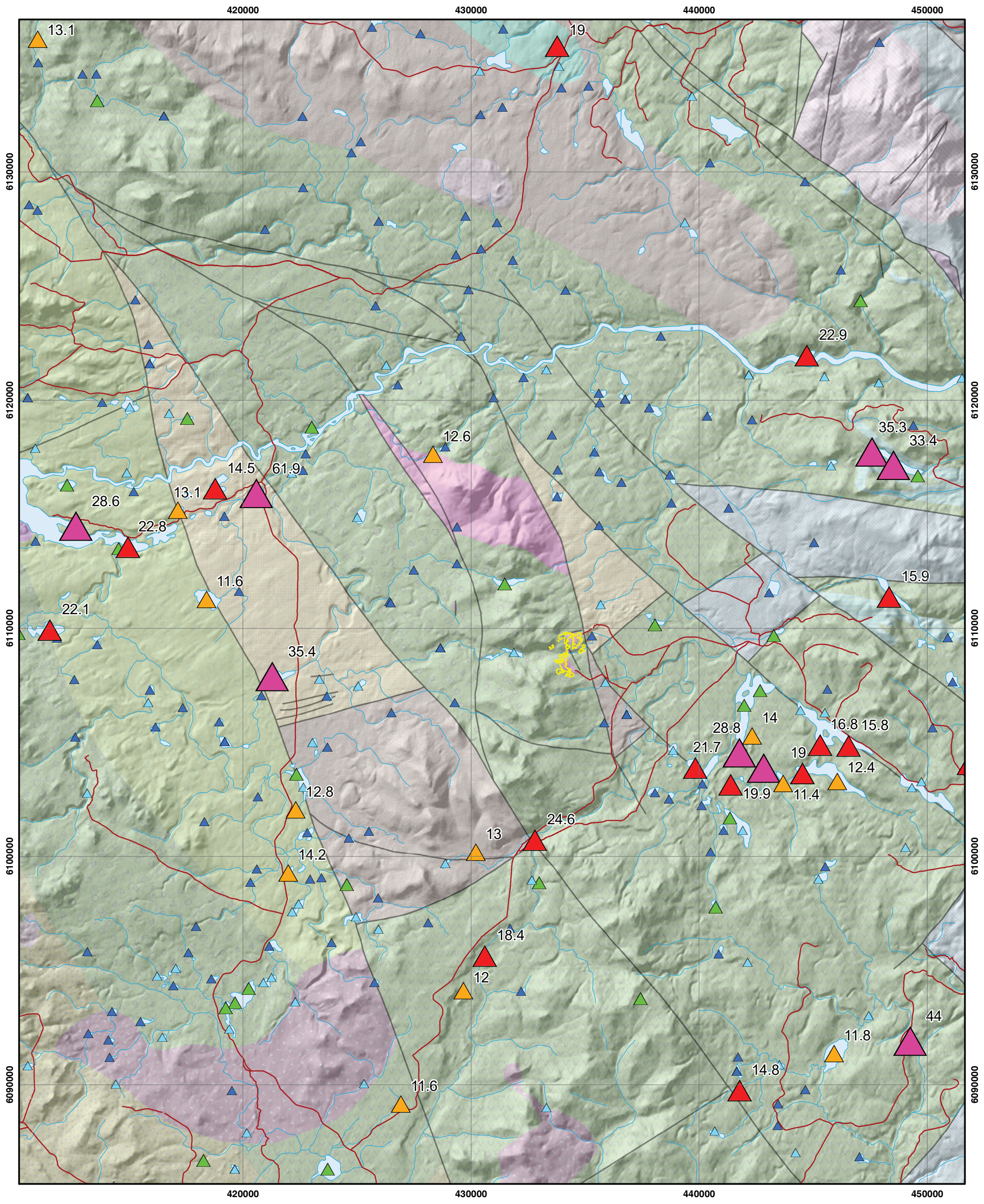
Geoscience BC

STREAM SEDIMENT GEOCHEMISTRY
Pathfinder Elements

1 : 300,000

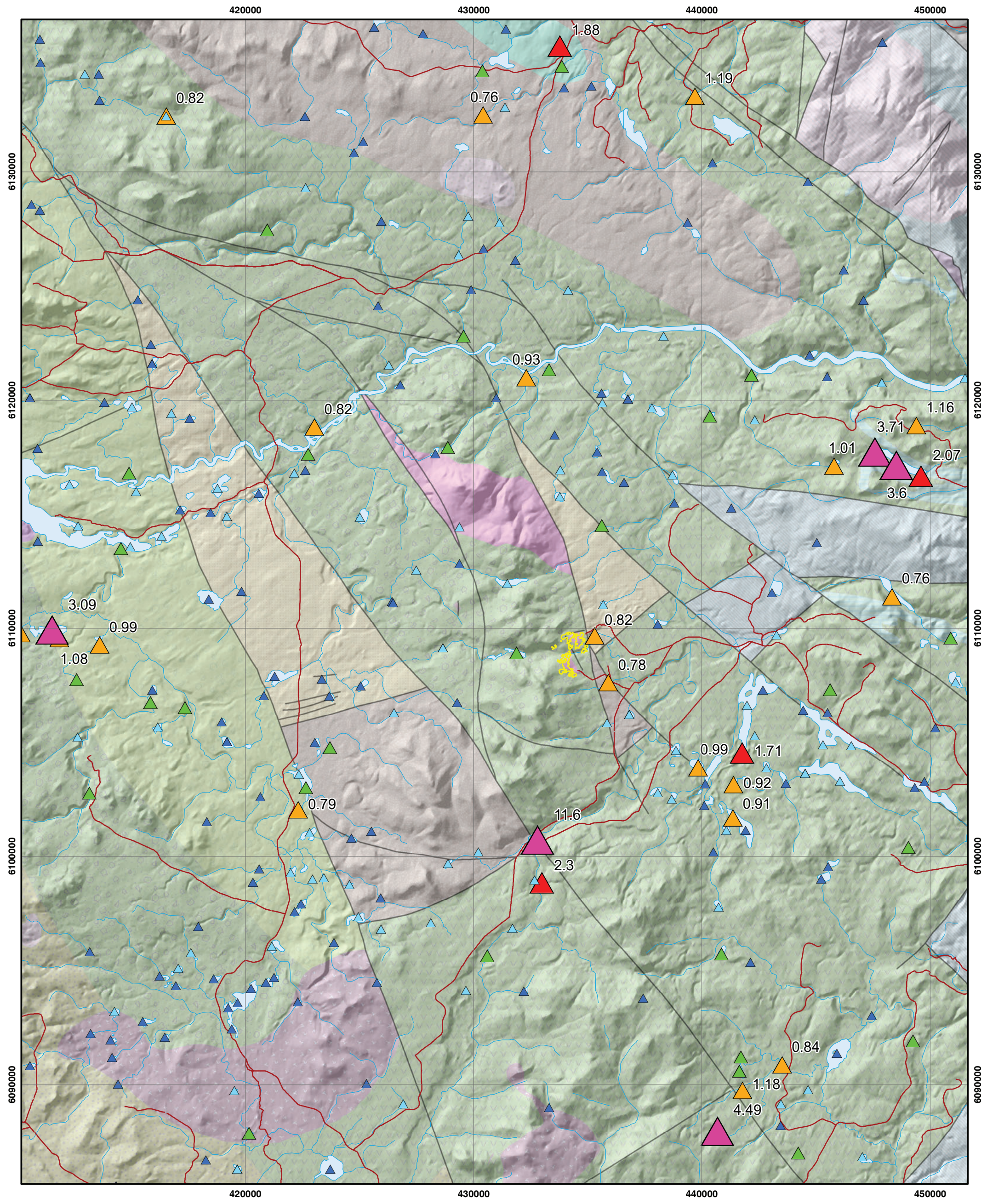


As

Stream Sediment

ppm

- 0.1 - 5.0
- 5.1 - 7.9
- 8.0 - 11.1
- 11.2 - 14.3
- 14.4 - 24.6
- 24.7 - 66.8



Sb

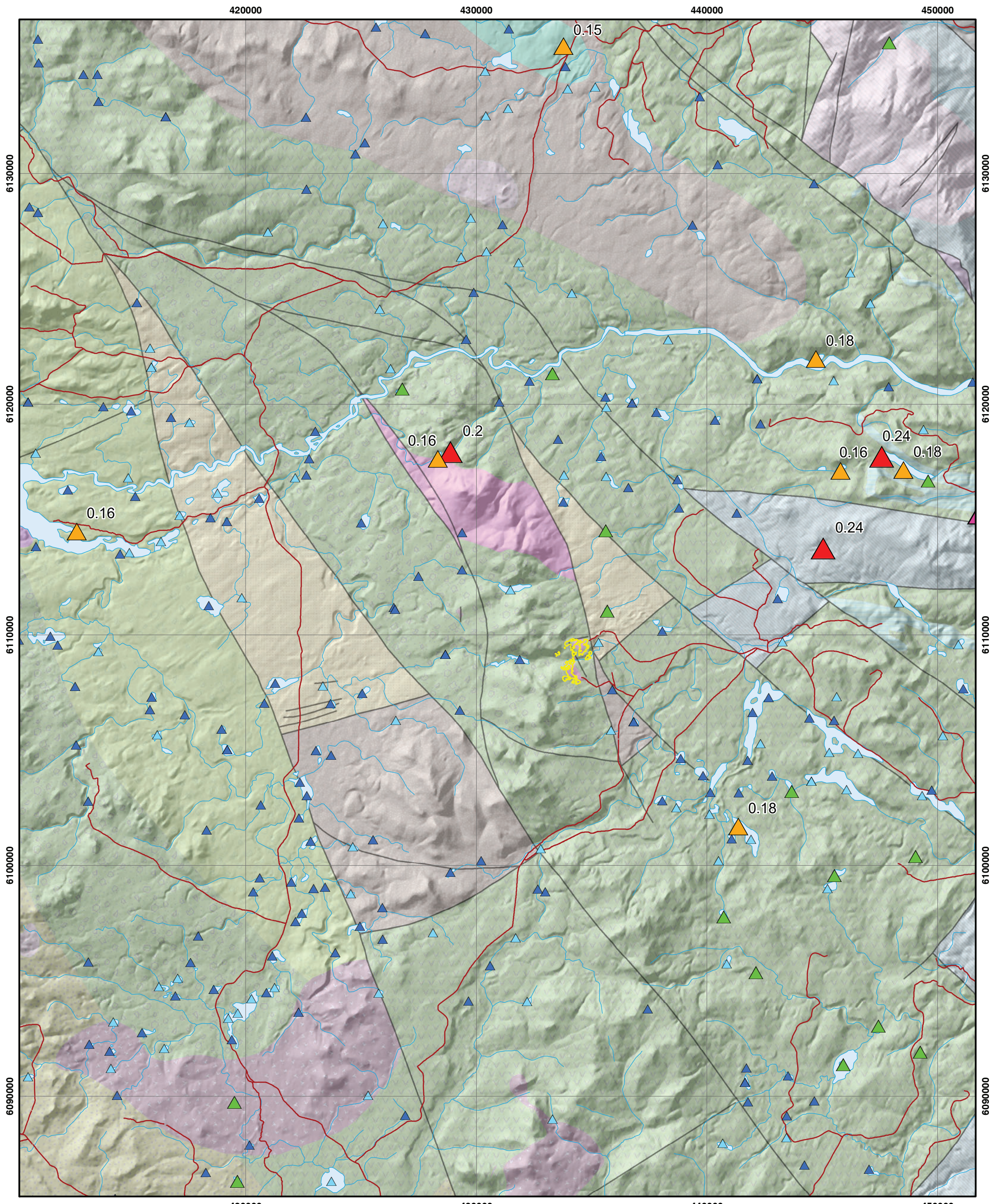
Stream Sediment

ppm (levelled)

- 0.00 - 0.41
- 0.42 - 0.57
- 0.58 - 0.75
- 0.76 - 1.19
- 1.20 - 2.29
- 2.30 - 11.60

Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)

limit of
> 0.15 % Cu grade
1010 bench (metres a.s.l.)
(projected to surface)

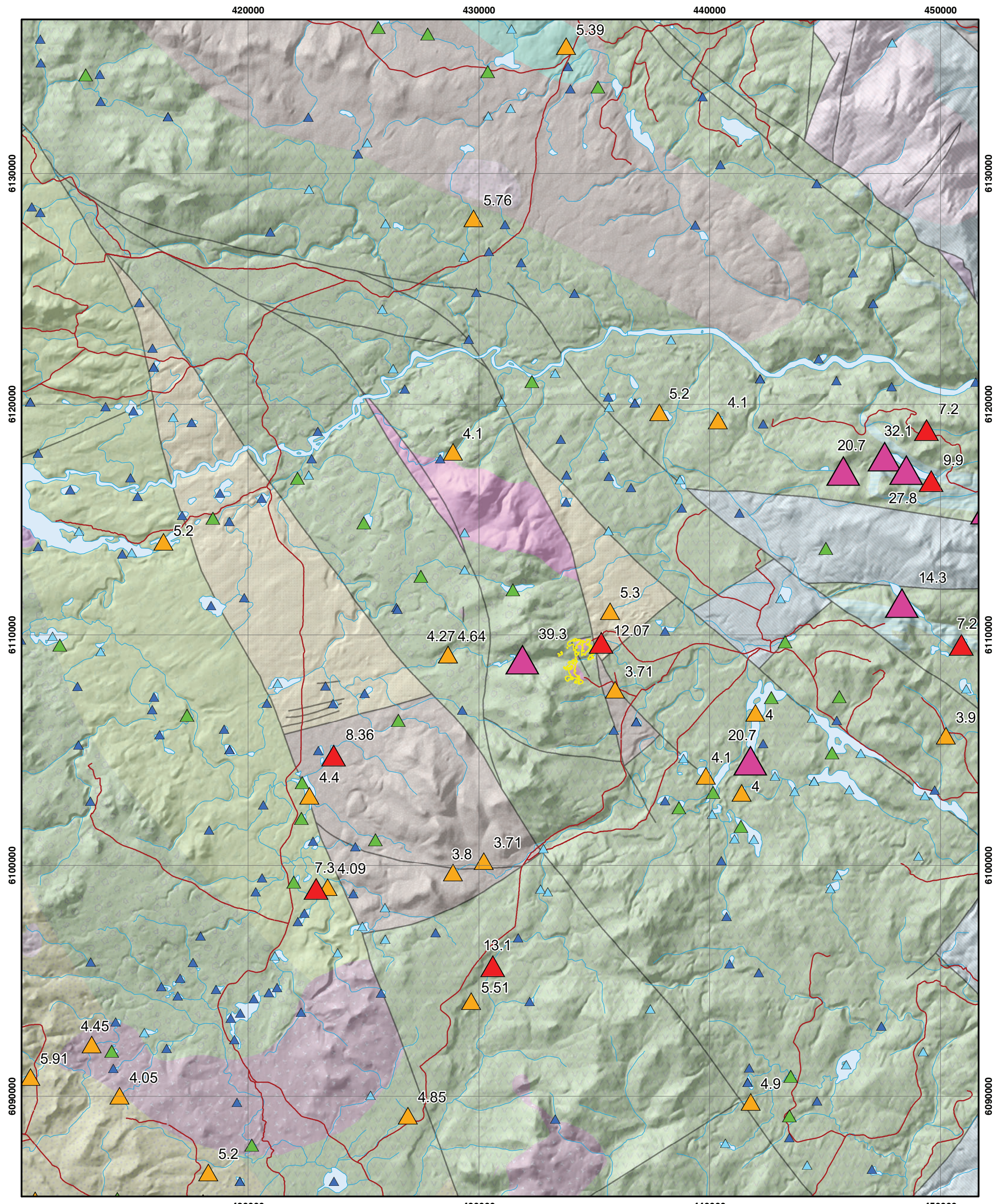


Tl

Stream Sediment

ppm (levelled)

- 0.00 - 0.07
- 0.08 - 0.11
- 0.12 - 0.14
- 0.15 - 0.18
- 0.19 - 0.24
- 0.25 - 0.44



Se

Stream Sediment

ppm (levelled)

- 0.00 - 1.30
- 1.31 - 2.30
- 2.31 - 3.71
- 3.72 - 6.57
- 6.58 - 13.10
- 13.11 - 39.30

Data Sources:

Rukhlov, A. and Naziri, M. (2015): Regional Geochemical Database 2015. British Columbia Ministry of Energy and Mines, British Columbia Geological Survey GeoFile 2015-03.

Including:

Jackaman, W. (2008): QUEST Project sample reanalysis; Geoscience BC, Report 2008-03, 4 p.

SCALE 1 : 300,000

0 10 20

kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

MT. MILLIGAN

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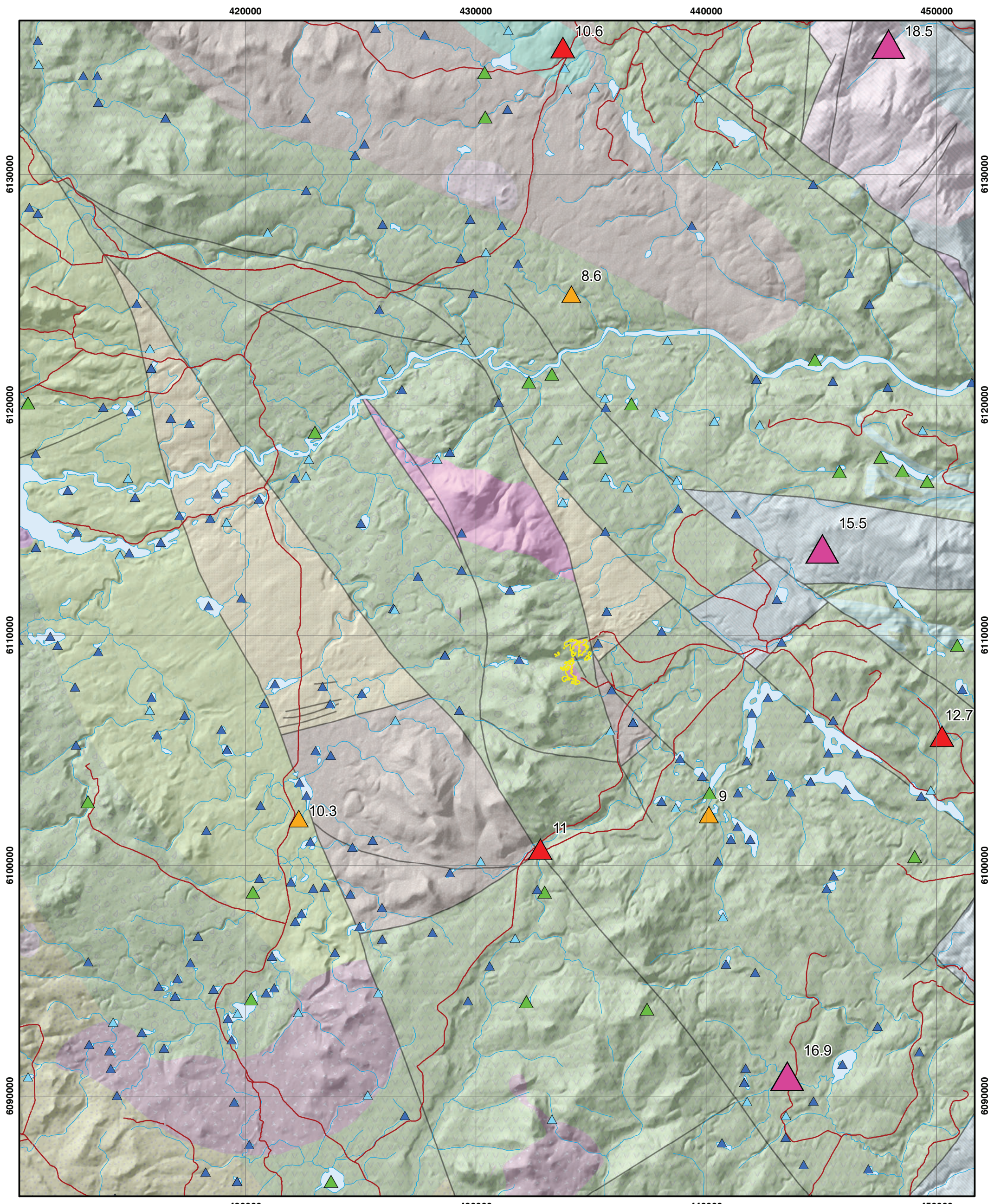
Geoscience BC

STREAM SEDIMENT GEOCHEMISTRY
Pathfinder Elements (Base Metals)

1 : 300,000

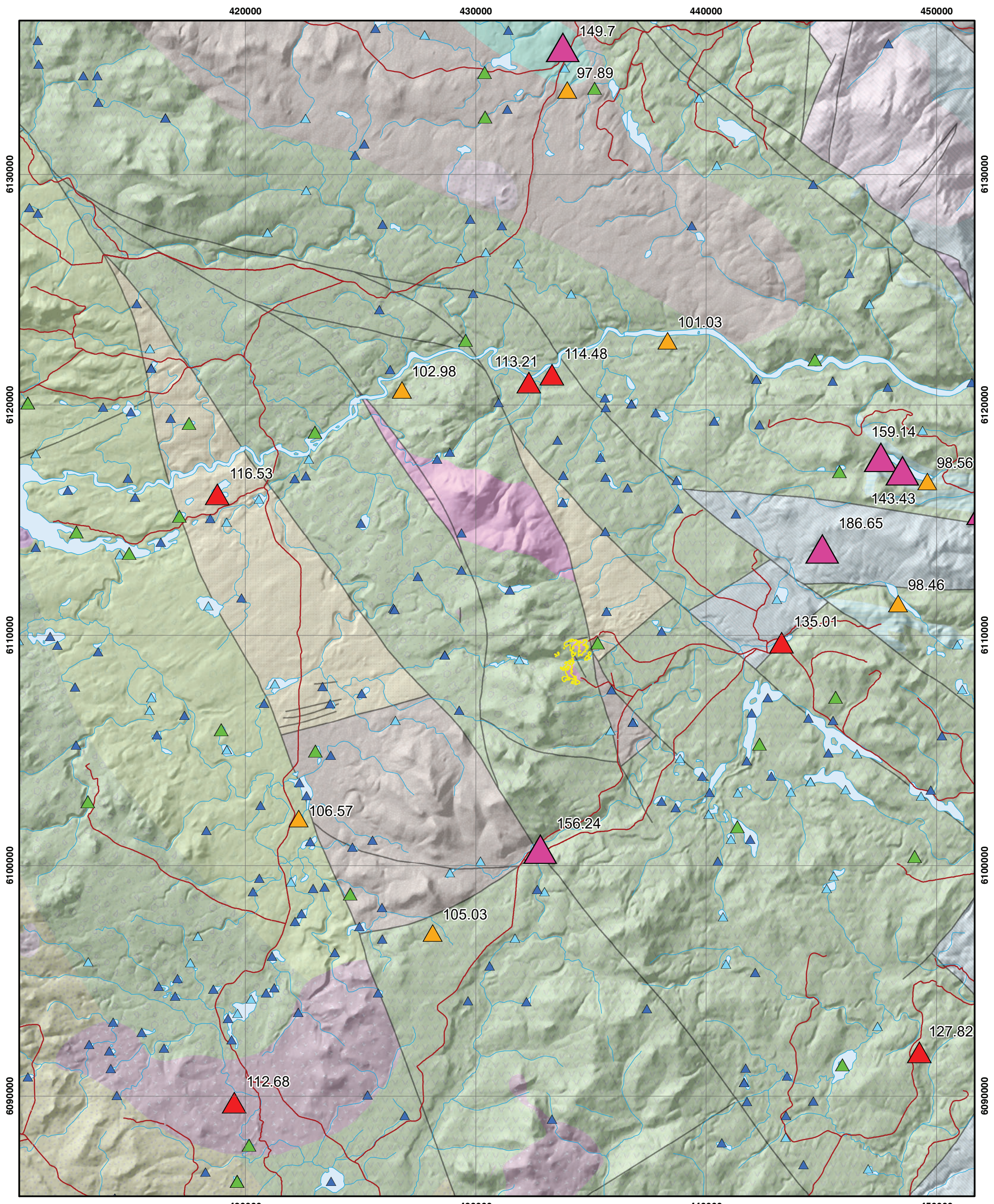


Pb

Stream Sediment

ppm (levelled)

- 0.0 - 5.5
- 5.6 - 7.1
- 7.2 - 8.5
- 8.6 - 10.5
- 10.6 - 14.1
- 14.2 - 24.7



Zn

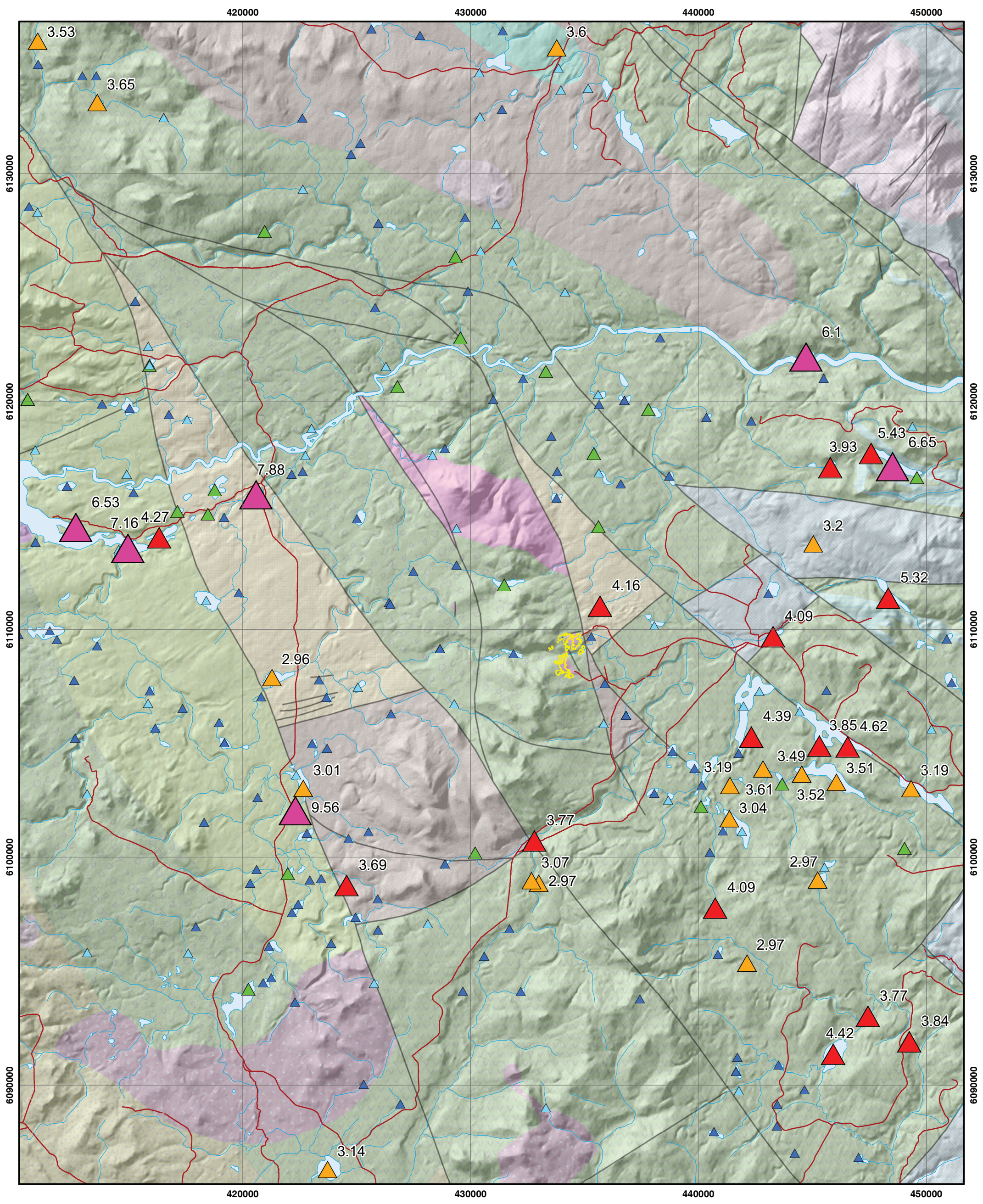
Stream Sediment

ppm (levelled)

- 0.00 - 59.38
- 59.39 - 81.41
- 81.42 - 97.10
- 97.11 - 112.60
- 112.61 - 142.30
- 142.31 - 1219.04

Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)

limit of
> 0.15 % Cu grade
1010 bench (metres a.s.l.)
(projected to surface)

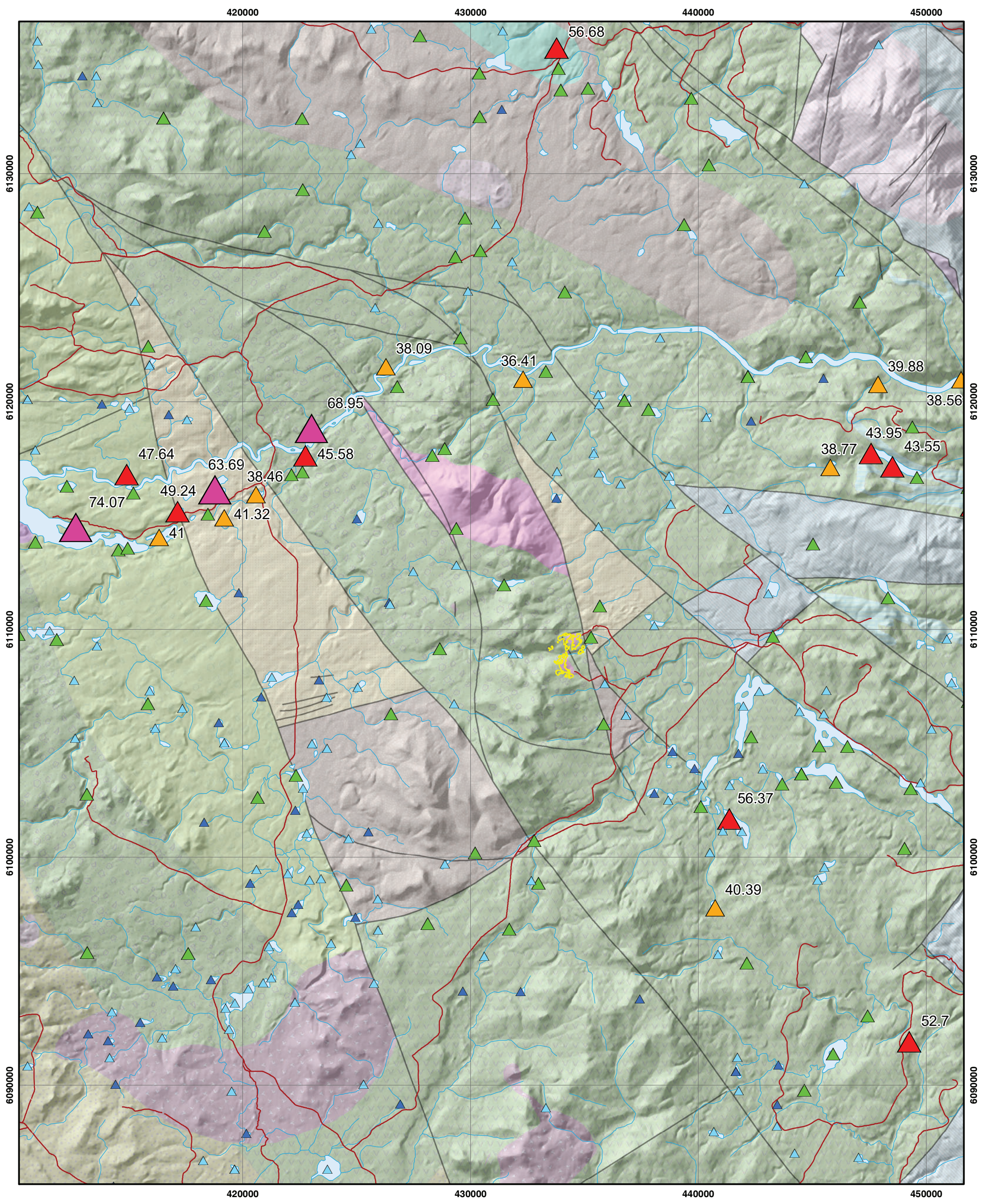


Fe

Stream Sediment

percent (levelled)

- 0.00 - 1.48
- 1.49 - 2.22
- 2.23 - 2.96
- 2.97 - 3.69
- 3.70 - 5.65
- 5.66 - 20.49



Ni

Stream Sediment

ppm (levelled)

- 0.00 - 10.33
- 10.34 - 20.35
- 20.36 - 35.61
- 35.62 - 42.48
- 42.49 - 58.60
- 58.61 - 103.42

Data Sources:

Rukhlov, A. and Naziri, M. (2015): Regional Geochemical Database 2015. British Columbia Ministry of Energy and Mines, British Columbia Geological Survey GeoFile 2015-03.

Including:

Jackaman, W. (2008): QUEST Project sample reanalysis; Geoscience BC, Report 2008-03, 4 p.

SCALE 1 : 300,000

0 10 20

kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

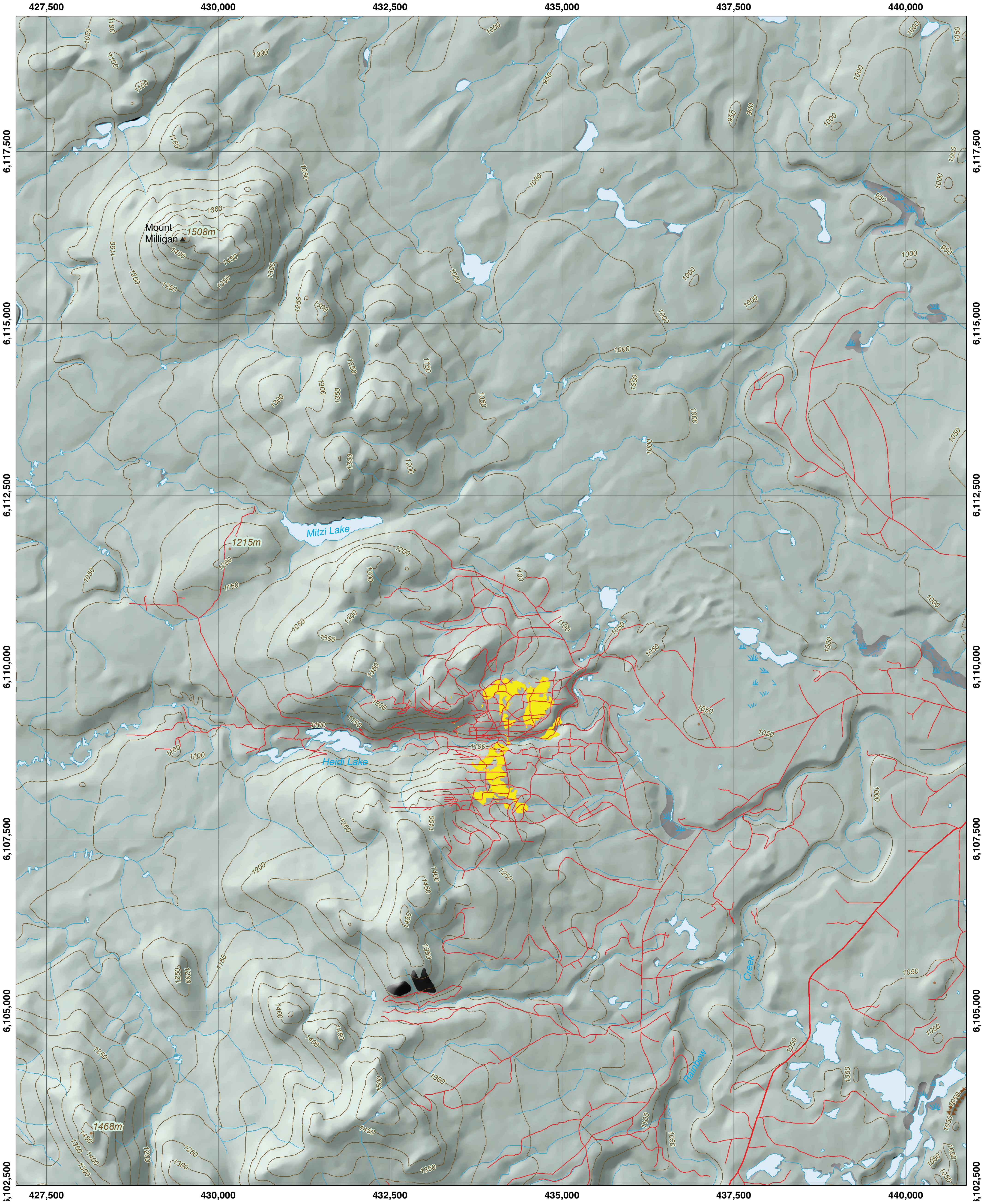
Porphyry Districts of British Columbia Atlas Series

MT. MILLIGAN

A geo-exploration atlas of the Mt. Milligan porphyry copper-gold district

TOPOGRAPHY
with Digital Shaded Relief

1 : 50,000



LEGEND

wetland

major road

minor road

wooded area

Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)

limit of
> 0.15 % Cu grade
1010 bench
(projected to surface)

SCALE 1 : 50,000

0 2.5 5

kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

Data Sources:

Natural Resources Canada (2017): CanVec, Canada, 093A05, 06, 11, and 12; Natural Resources Canada, Earth Sciences Sector, Mapping Information Branch, Centre for Topographic Information, URL <http://geogratis.gc.ca> [May 2017]

GeoBC, 2017: Digital Road Atlas; Crown Registry and Geographic Base, Province of British Columbia, URL < http://archive.ilmb.gov.bc.ca/crgb/products/mapdata/digital_road_atlas_products.htm> [May, 2017]

Porphyry Districts of British Columbia Atlas Series

MT. MILLIGAN

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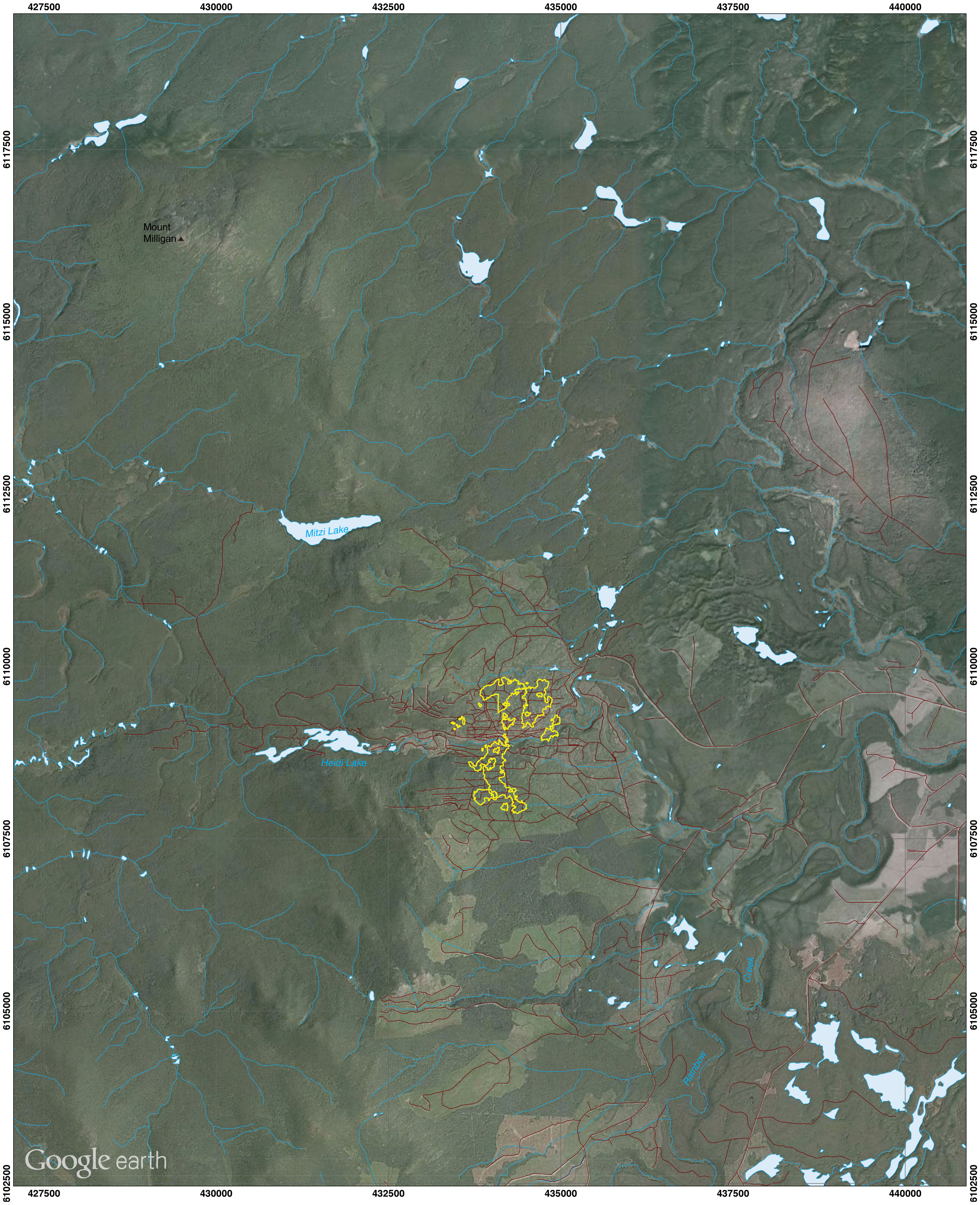
Geoscience BC

SATELLITE IMAGERY
Google Earth - SPOT
1 : 50,000



Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)

limit of
> 0.15 % Cu grade
1010 bench
(projected to surface)

SCALE 1 : 50,000

0 2.5 5

kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

Data Sources:

Google Earth
Image © 2013 Province of British Columbia
© 2013 Google
© 2013 Cnes/Spot Image

MT. MILLIGAN

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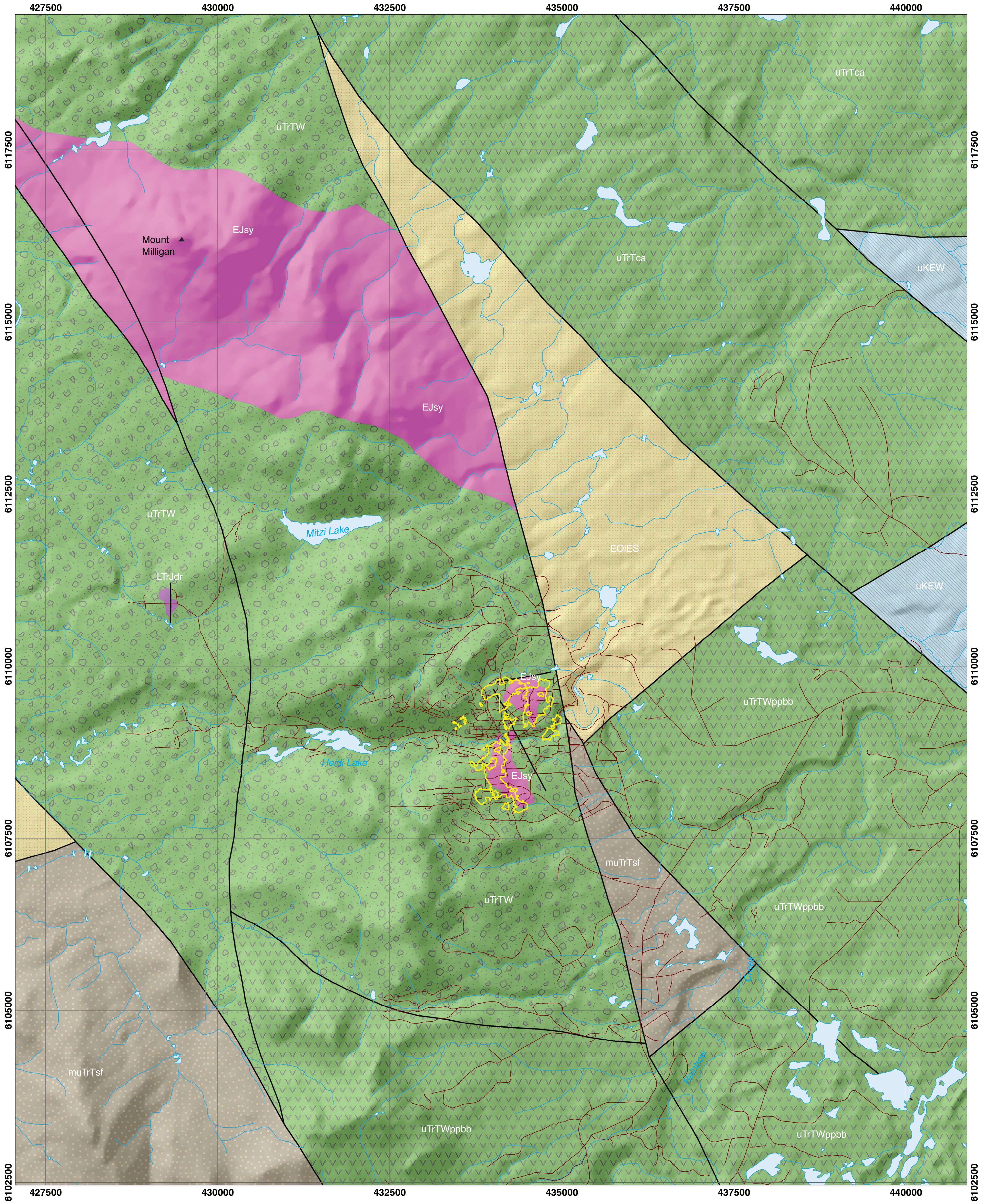
Geoscience BC

BEDROCK GEOLOGY

1 : 50,000



LEGEND

Overlap assemblages and postaccretionary rocks

EOCENE - OLIGOCENE

- EOIEs — Nechako Plateau Group sedimentary rocks: Sandstone, mudstone, pebble conglomerate, volcanic wacke, volcanic ash and basalts

Triassic-Jurassic Quesnel terrane

EARLY JURASSIC (intrusive rocks)

- EJsy — Syenitic to monzonitic intrusions

LATE TRIASSIC (Intrusive rocks)

- LTrJdr — Dioritic intrusive rocks

MIDDLE - UPPER TRIASSIC (stratified rocks)

Takla Group

- muTrTsf — Sedimentary rocks: Mudstone, siltstone, shale, fine clastic rocks
- uTrT — Calc-alkaline volcaniclastic rocks, incl. Witch Lake Formation (uTrTW): Dominated by volcanic flows, breccia and agglomerates; augite with lessor plagioclase bearing rocks
- TrJTvb uTrTca — Calc-alkaline volcanic rocks, incl. Witch Lake Formation (uTrTWppbb): Augite-phyric and aphyric basalt breccia, agglomerate, tuff and flows.

Continental margin assemblages

UPPER PROTEROZOIC

- uKEW — Wolverine Metamorphic Complex: Muscovite and biotite schist, paragneiss Neoproterozoic rocks with overprinting metamorphic–deformational event in the Middle to Late Jurassic or earlier. Record predominantly Late Jurassic to Early Cretaceous uplift of the complex, with Eocene resetting.

Symbols

- roads
- fault
- geological contact

Mt. Milligan orebodies

(Centerra 2017, *in* Andrews et al., 2017)

- limit of > 0.15 % Cu grade 1010 bench (projected to surface)

SCALE 1 : 50,000

0 2.5 5

kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

Data Sources:

Compilation map:

Logan, J.M., Schiarizza, P., Struik, L.C., Barnett, C., Nelson, J.L., Kowalczyk, P., Ferri, F., Mihalynuk, M.G., Thomas, M.D., Gammon, P., Lett, R., Jackaman, W. and Ferbey, T., 2010: Bedrock Geology of the QUEST map area, central British Columbia; British Columbia Geological Survey Geoscience Map 2010-1, Geoscience BC Report 2010-5, and Geological Survey of Canada Open File 6476.

Digital files of above publication are included in:

Cui, Y., Miller, D., Schiarizza, P., and Diakow, L.J., 2017. British Columbia digital geology. British Columbia Ministry of Energy, Mines and Petroleum Resources, British Columbia Geological Survey Open File 2017-8, 9p. Data version 2019-12-19.

Original mapping:

Nelson, J.L. and Bellefontaine, K.A. (1996): The geology and mineral deposits of north-central Quesnellia; Tezzeron Lake to Discovery Creek, central British Columbia; Bulletin 99, BC Geological Survey, 116 p.

Porphyry Districts of British Columbia Atlas Series

MT. MILLIGAN

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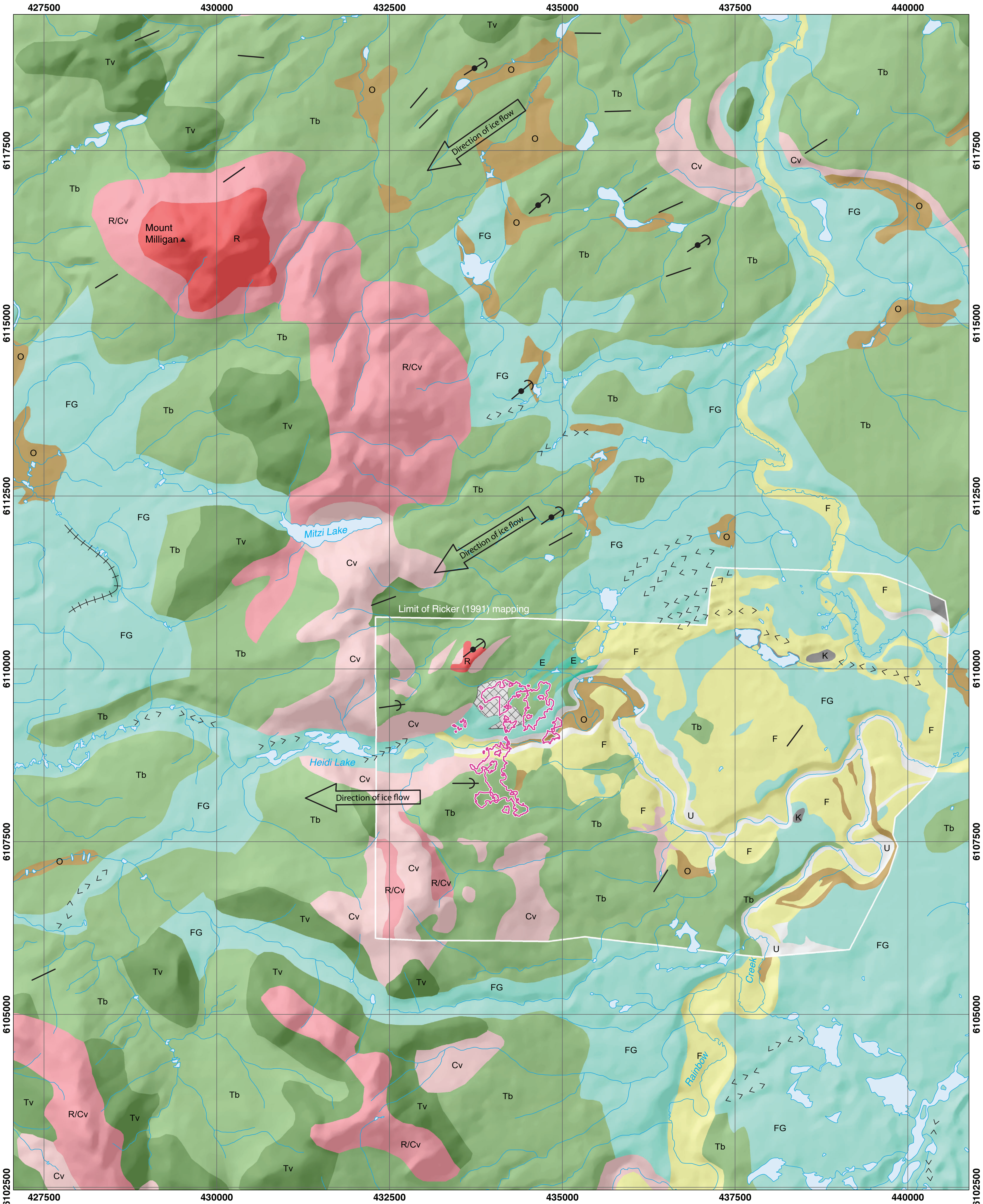
Geoscience BC

SURFICIAL GEOLOGY

1 : 50,000



LEGEND

Non-glacial environment

- Anthropogenic deposits
- O Organic deposits

Glacial and proglacial environment

- F Fluvial
- K Kettle
- E Esker
- FG Glaciofluvial
- Tv Till, morainal veneer
- Tb Till, morainal blanket

Bedrock and colluvium

- Cv Colluvium
- R/Cv Bedrock & colluvium
- R Bedrock

- U Undifferentiated

Ice Flow Indicators & Geological Features

- Undifferentiated lineations and flutings
- Drumlin, ice flow direction indicated
- Striae/grooves, ice flow direction indicated
- Meltwater channel
- Esker, flow direction unknown
- Esker, flow direction indicated

Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)

- limit of > 0.15 % Cu grade 1010 bench (projected to surface)

SCALE 1 : 50,000

0 2.5 5

kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

Data Sources:

Kerr, D.E. (1991): Surficial geology of the Mount Milligan Area; British Columbia Ministry of Energy, Mines and Petroleum Resources, Open File 1991-07, scale 1:50,000.

Ricker, K.E. (1991): A preliminary appraisal of the surficial geology of the Mt. Milligan mine site with special reference to tailings impoundment area "A"; Internal report prepared for Placer Dome Inc. Project Development.

Arnold, H. and Ferbey, T. (2020): Ice-flow indicator database, British Columbia and Yukon. British Columbia Ministry of Energy and Mines and Petroleum Resources, British Columbia Geological Survey Open File 2020-03, 1p.

This map is depicts the surficial geology in the Mount Milligan area, simplified from 1:50,000 scale mapping by Kerr (1991), with an inset of more detailed work by Ricker (1991).

Porphyry Districts of British Columbia Atlas Series

MT. MILLIGAN

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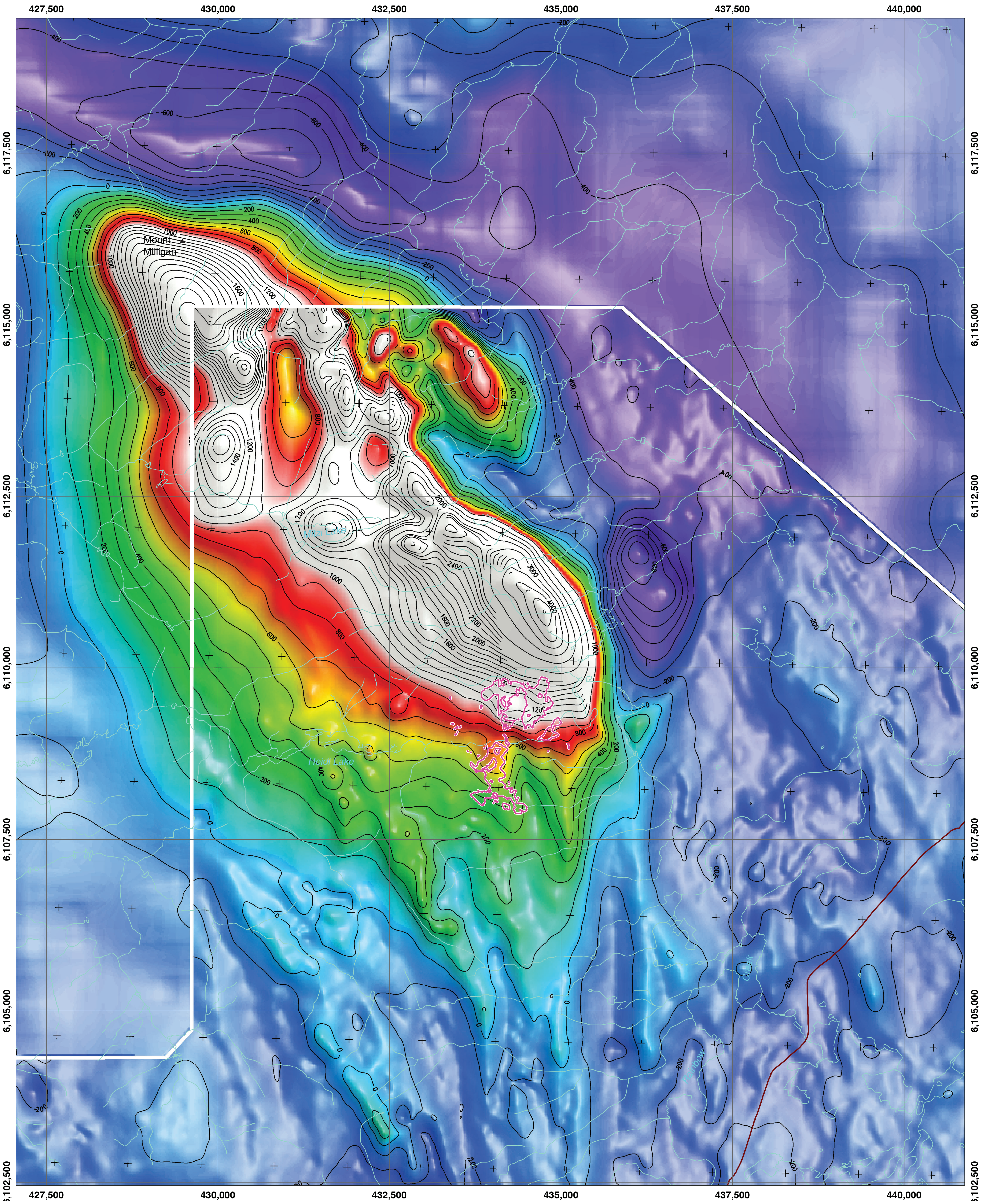
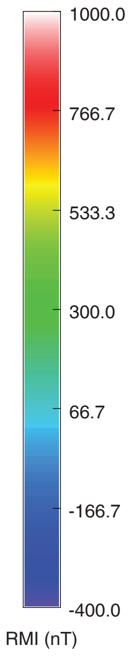
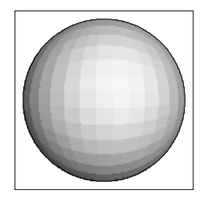
Geoscience BC

MAGNETICS
Residual Magnetic Intensity
1 : 50,000

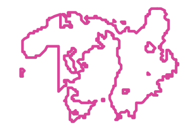






Azimuth : 45
Inclination : 75

Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)



limit of
> 0.15 % Cu grade
1010 bench
(projected to surface)

SCALE 1 : 50,000

0 2.5 5

kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

Data Sources:

Data from http://gdr.agg.nrcan.gc.ca
Geological Survey of Canada data set used was downloaded from the Canadian Aeromagnetic database.

2008 VTEM survey:
Geotech Limited, 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 & 94C, D); Geoscience BC, Report 2008-04.

Data has been merged and adjusted to a Residual Magnetic Intensity value using the NRCAN national 200m grid.

Data range -965 nT to 4914 nT.

Porphyry Districts of British Columbia Atlas Series

MT. MILLIGAN

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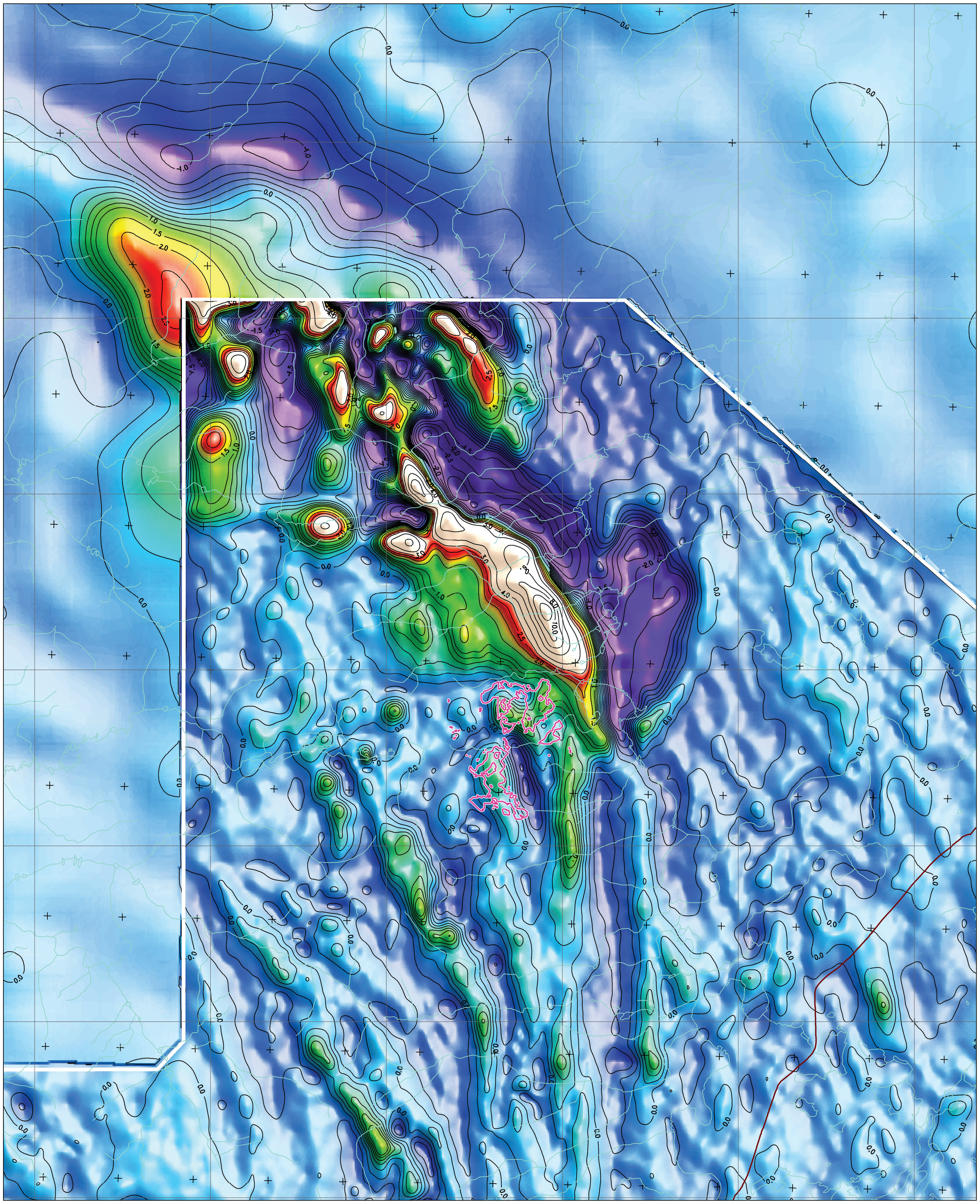
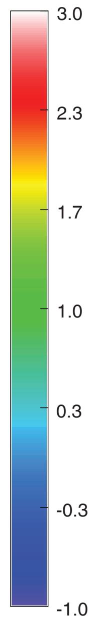
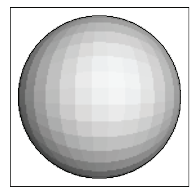
Geoscience BC

MAGNETICS
First Vertical Derivative
1 : 50,000







Azimuth : 45
Inclination : 53

Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)

limit of
> 0.15 % Cu grade
1010 bench
(projected to surface)

SCALE 1 : 50,000

0 2.5 5
kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

Data Sources:

Data from http://gdr.agg.nrcan.gc.ca
Geological Survey of Canada data set used was downloaded from the Canadian Aeromagnetic database.

2008 VTEM survey:
Geotech Limited, 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 & 94C, D); Geoscience BC, Report 2008-04.

NRCAN 1VD data has been downward continued 100m to sharpen anomalies.

In the Mt. Milligan area, the 2008 VTEM survey 1VD was calculated from the TMI data and upward continued 50 metres to improve anomaly shapes. Note that the 2008 VTEM data has been collected closer to the ground and at a tighter line spacing; as a result it has much more detail.

Data range 5.3 nT/m to 13.6 nT/m.

Porphyry Districts of British Columbia Atlas Series

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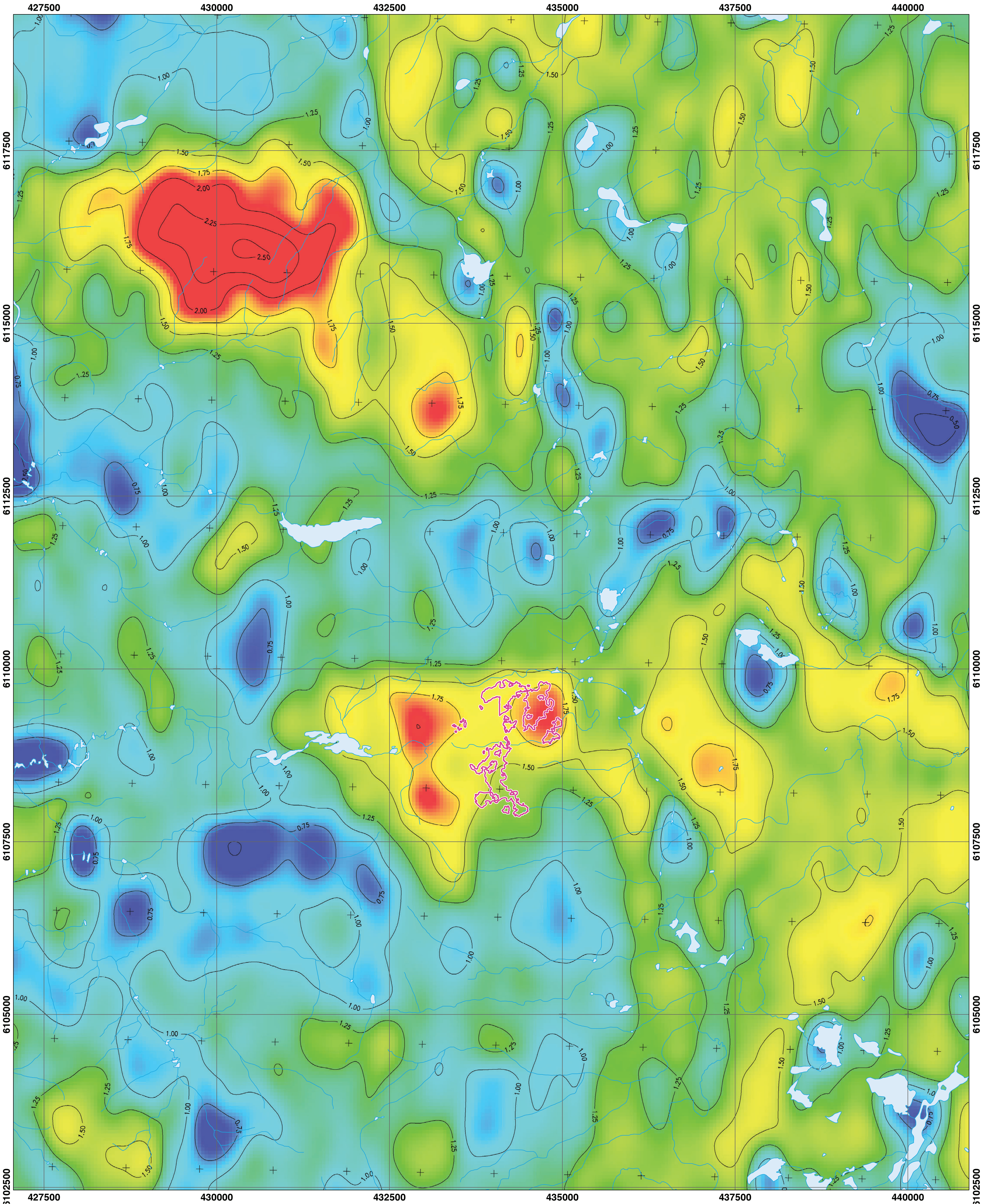
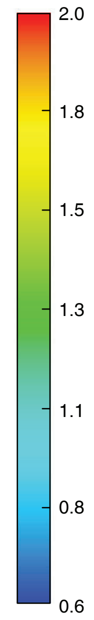
Geoscience BC

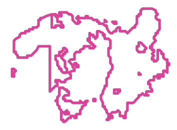
RADIOMETRICS
% Potassium
1 : 50,000





% Potassium

Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)



limit of
> 0.15 % Cu grade
1010 bench
(projected to surface)

SCALE 1 : 50,000

0 2.5 5
kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

Data Sources:

Data from http://gdr.agg.nrcan.gc.ca
These data may be readily used for commercial, personal and public use and may be reproduced, in part or in whole and by any means, without charge for further permission from Natural Resources Canada.

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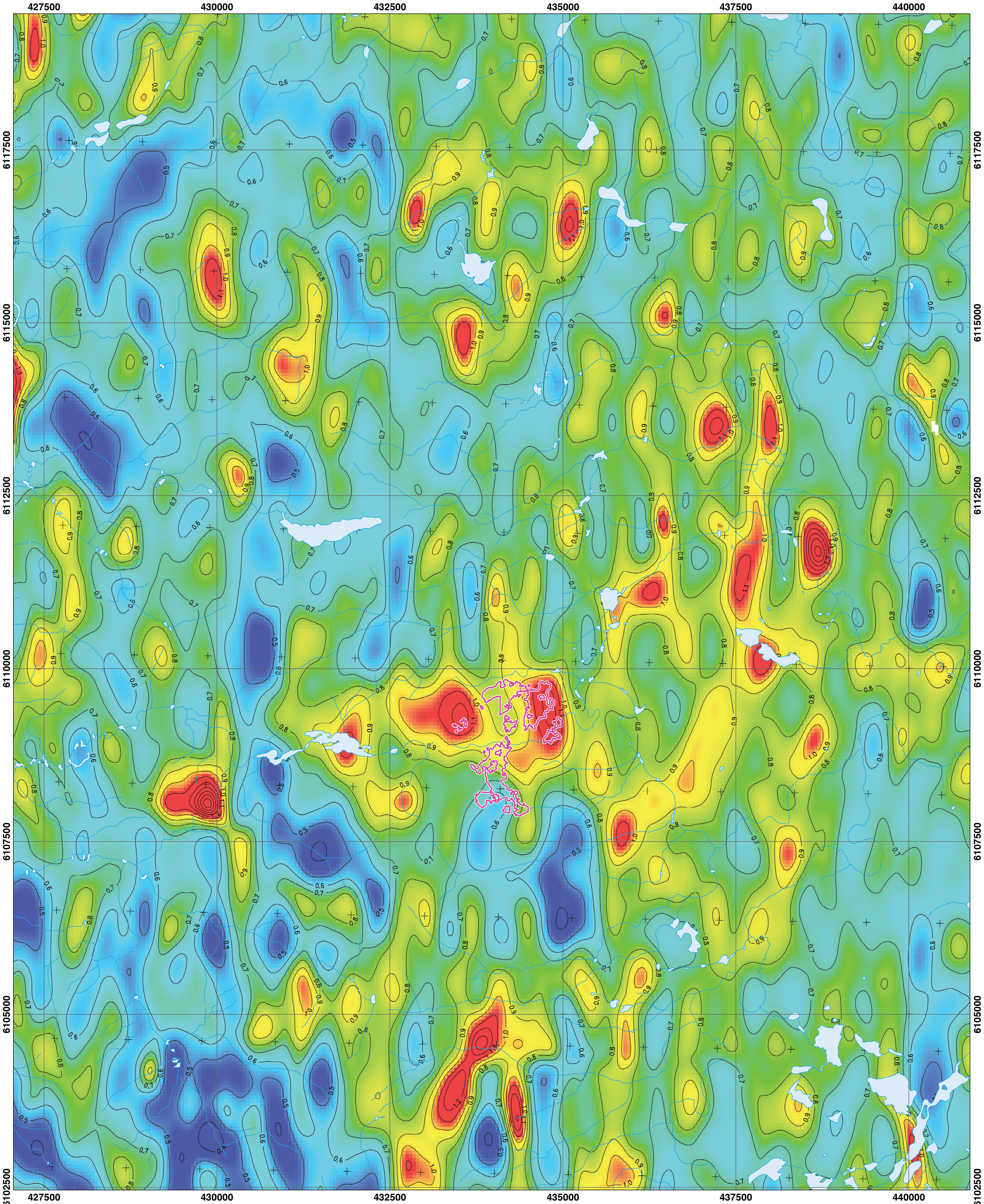
Radioactivity Data
Citation 2017:
National Gamma-Ray Spectrometry Program Data Base
Airborne Geophysics Section, GSC - Central Canada Division
Geological Survey of Canada, Earth Sciences Sector
Natural Resources Canada

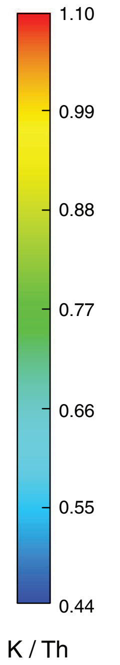
MT. MILLIGAN

A geo-exploration atlas of the Mt. Milligan porphyry copper-gold district

Geoscience BC

RADIOMETRICS
K / eTh
1 : 50,000





Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)

limit of
> 0.15 % Cu grade
1010 bench
(projected to surface)

SCALE 1 : 50,000

0 2.5 5

kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

Data Sources:

Data from http://gdr.agg.nrcan.gc.ca
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Radioactivity Data
Citation 2017:
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Porphyry Districts of British Columbia Atlas Series

MT. MILLIGAN

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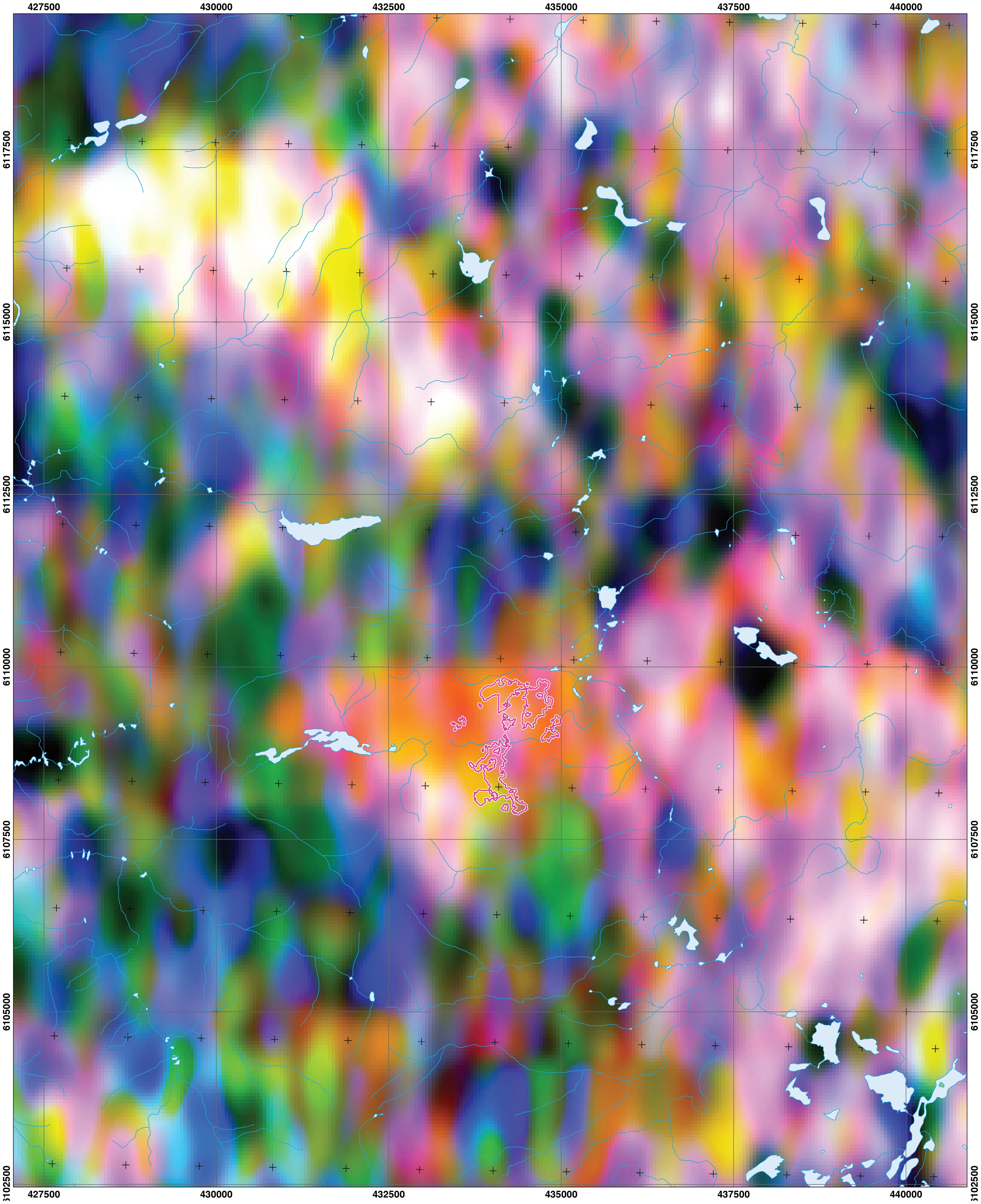
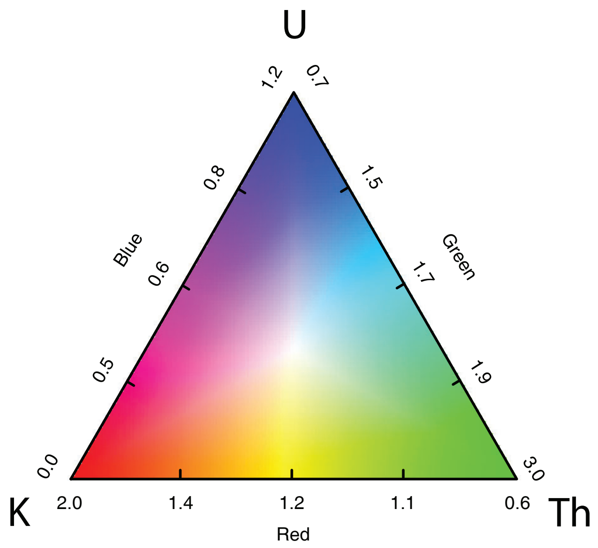
Geoscience BC

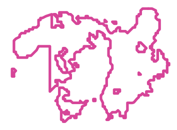
RADIOMETRICS
KTU / RGB
1 : 50,000





Red : Combined Percent Potassium
Green : Combined Equivalent Thorium
Blue : Combined Equivalent Uranium

Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)



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SCALE 1 : 50,000

0 2.5 5
kilometres

Universal Transverse Mercator Projection
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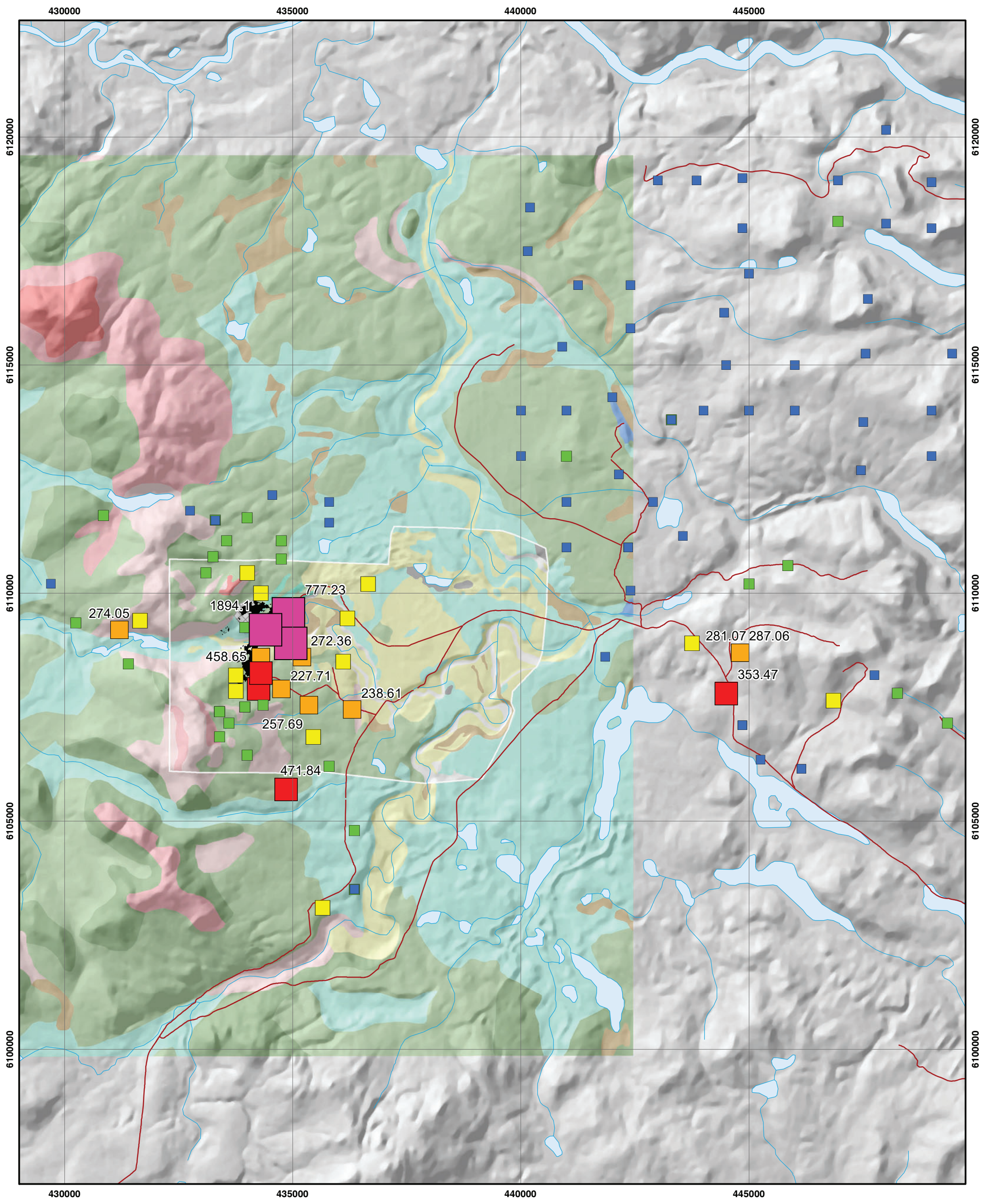
Geoscience BC

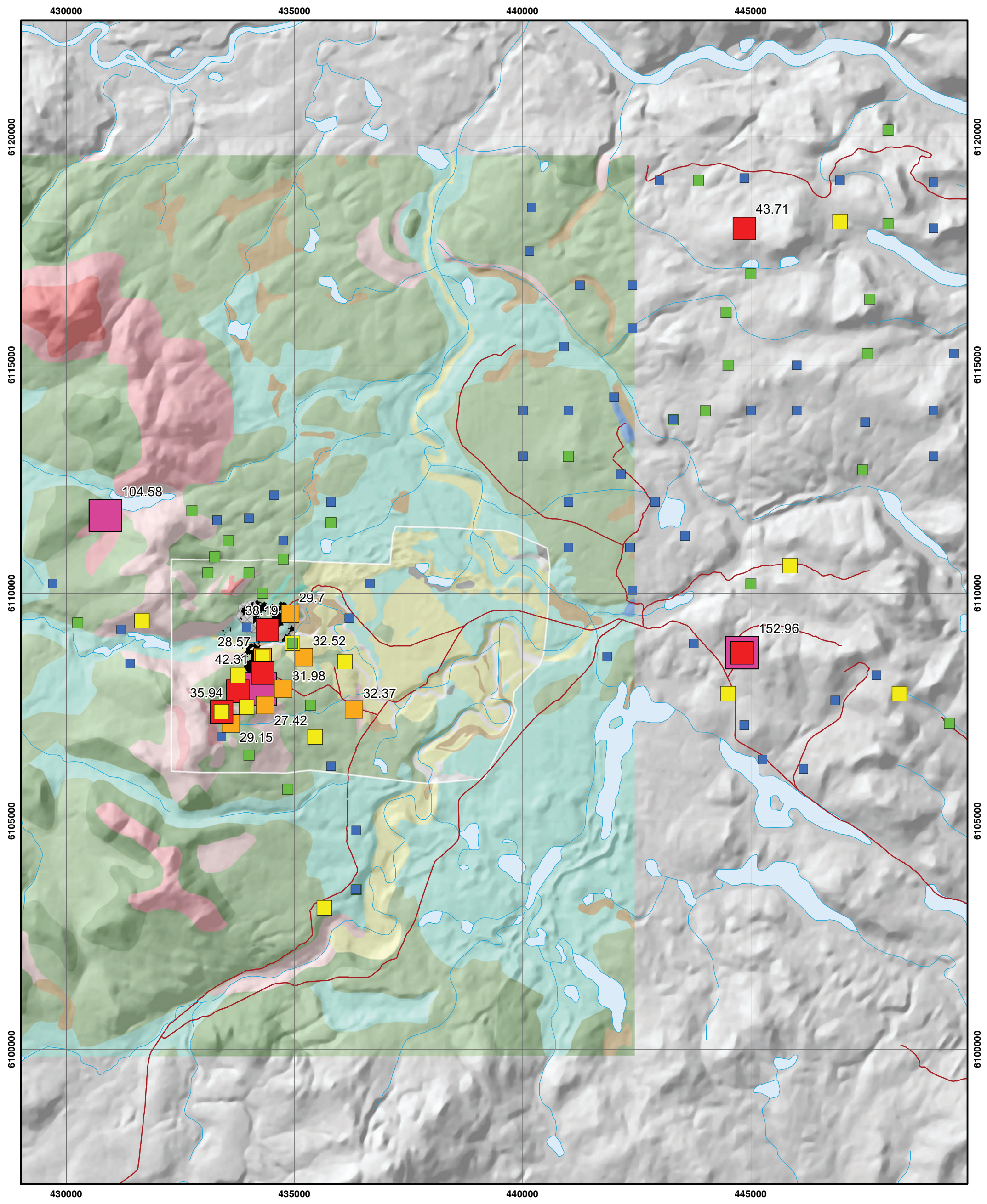
TILL
Commodity Elements
1 : 150,000



Cu

ppm

- 17.21 - 67.47
- 67.48 - 144.09
- 144.10 - 227.71
- 227.72 - 287.06
- 287.07 - 777.22
- 777.23 - 1894.10



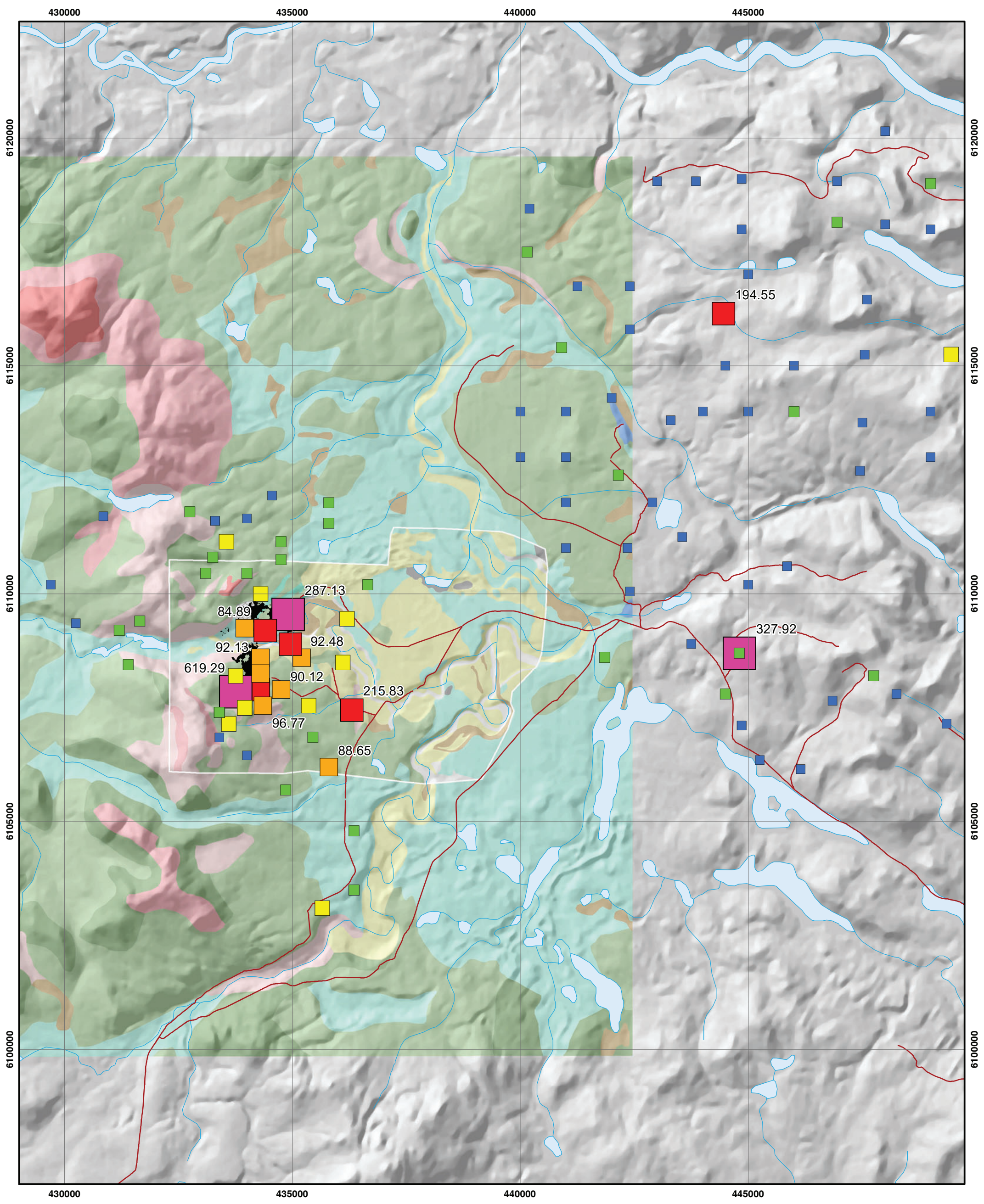
As

ppm

- 2.66 - 10.29
- 10.30 - 18.68
- 18.69 - 27.42
- 27.43 - 35.94
- 35.95 - 75.87
- 75.88 - 152.96

Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)

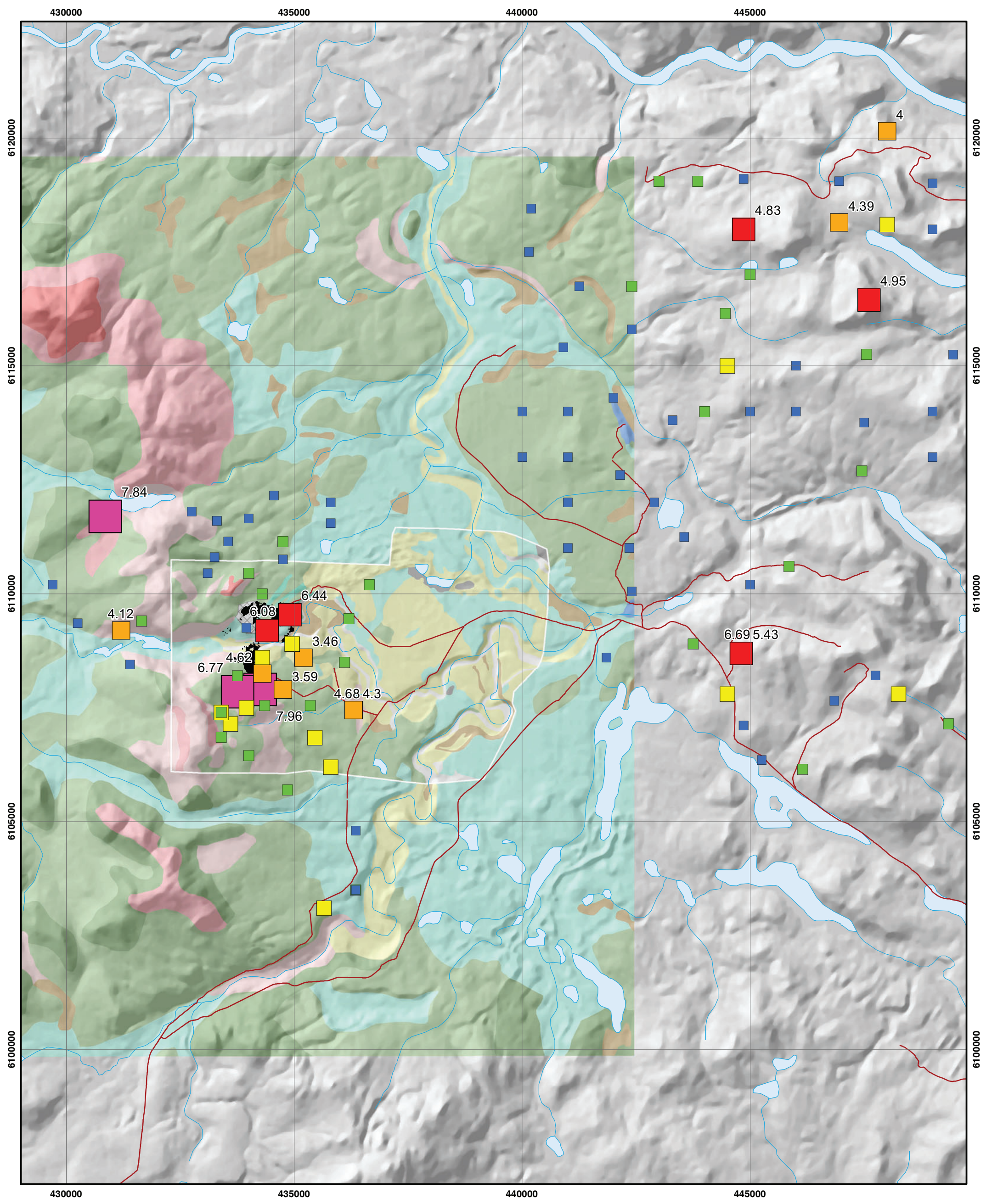
limit of
> 0.15 % Cu grade
1010 bench
(projected to surface)



Au

ppb

- 1.53 - 18.89
- 18.90 - 43.19
- 43.20 - 84.89
- 84.90 - 163.19
- 163.20 - 287.13
- 287.14 - 619.29



Sb

ppm

- 0.39 - 1.65
- 1.66 - 2.47
- 2.48 - 3.46
- 3.47 - 4.83
- 4.84 - 6.76
- 6.77 - 7.96

Data Sources:

Sibbick, S., Balma, R.G., Dunn, C.E. (1996): Till Geochemistry of the Mount Milligan Area (Parts of 93N/1 & 93O/4; British Columbia Ministry of Energy, Mines and Petroleum Resources, Open File 1996-22.

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SCALE 1 : 150,000

0 5 10
kilometres

Universal Transverse Mercator Projection
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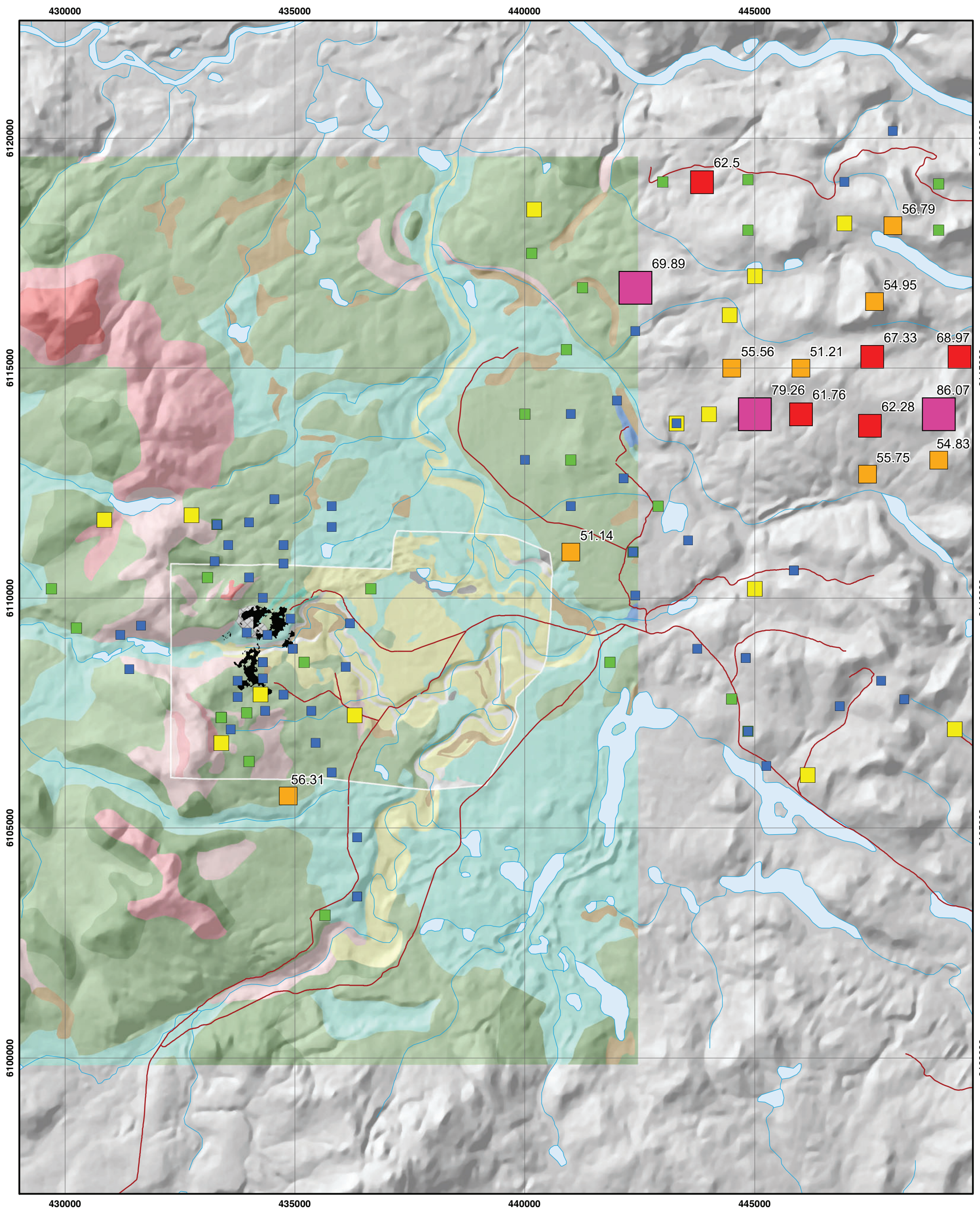
Geoscience BC

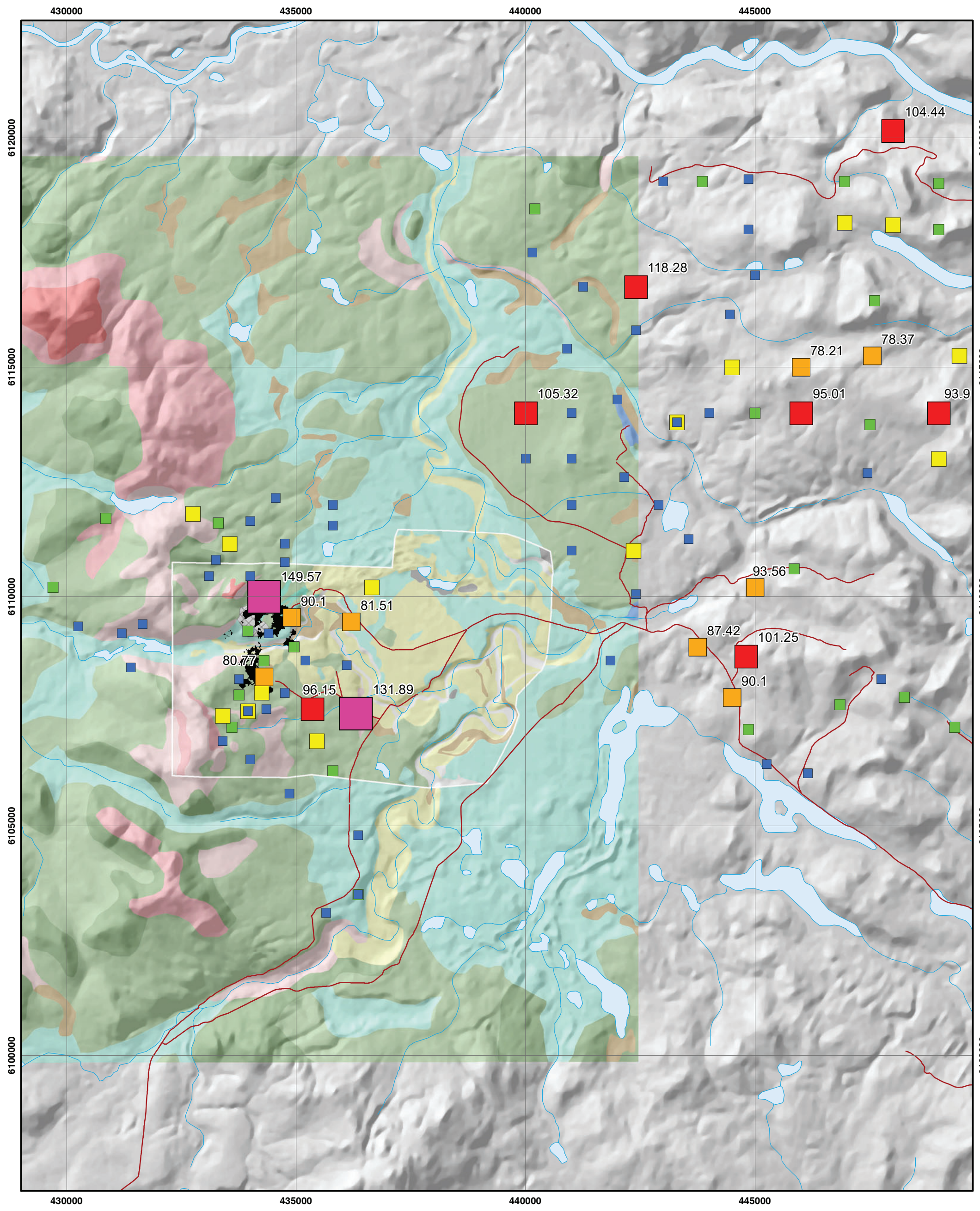
TILL
Rare Earth Elements & Co, Cr
1 : 150,000



Ce

ppm

- 19.57 - 36.45
- 36.46 - 45.21
- 45.22 - 51.14
- 51.15 - 61.75
- 61.76 - 69.89
- 69.90 - 86.07



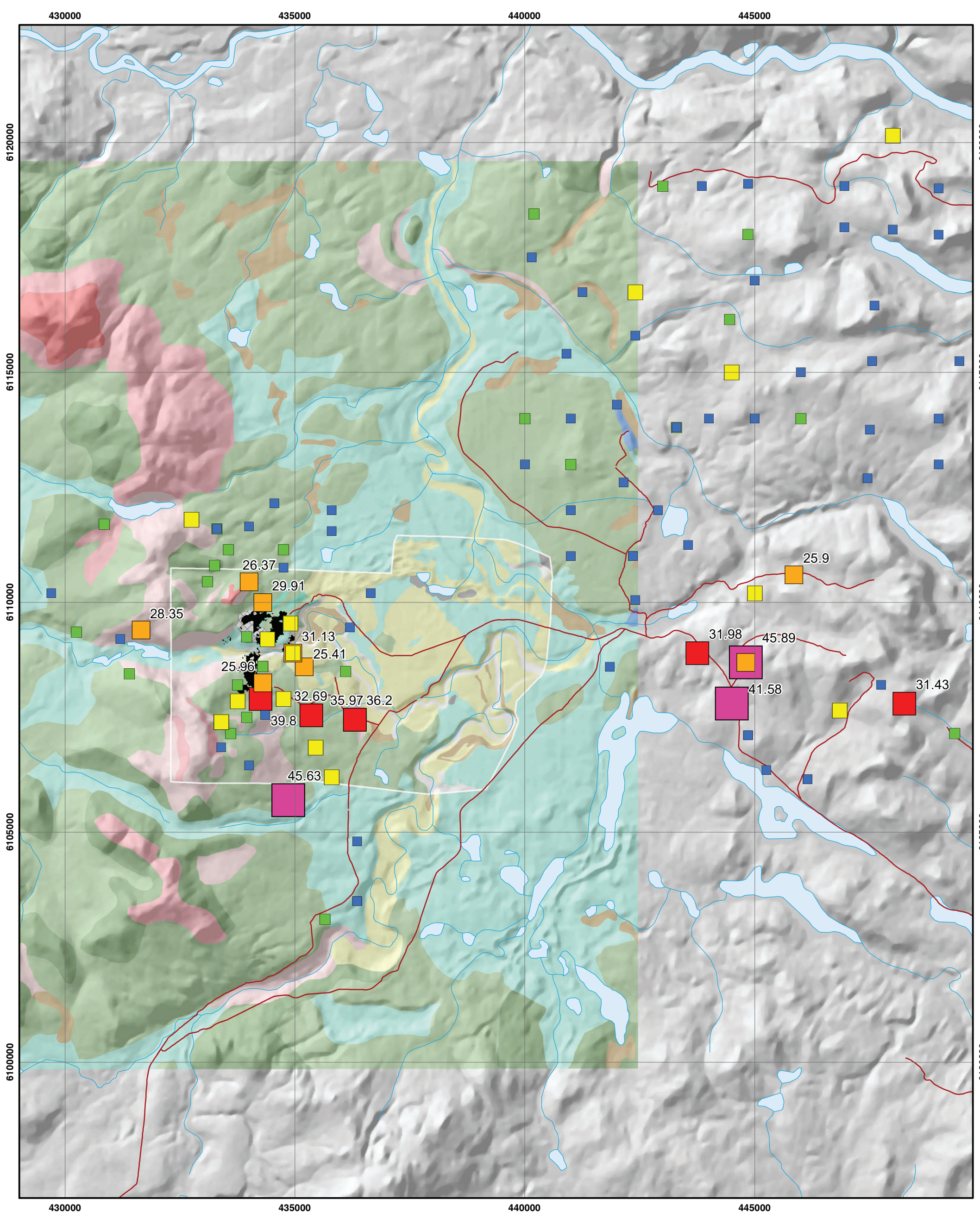
Rb

ppm

- 5.69 - 50.09
- 50.10 - 65.74
- 65.75 - 78.21
- 78.22 - 93.89
- 93.90 - 118.28
- 118.29 - 149.57

Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)

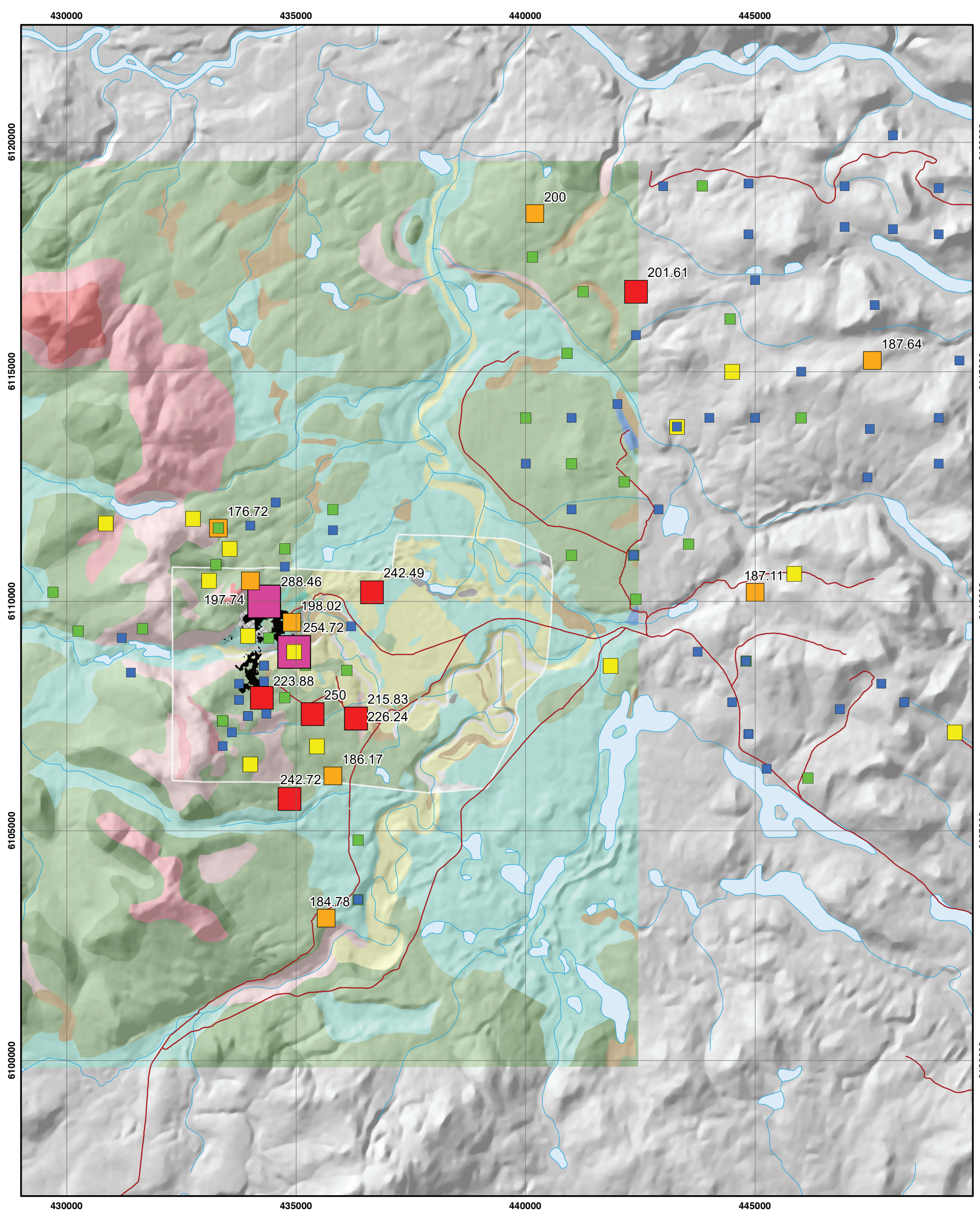
limit of
> 0.15 % Cu grade
1010 bench
(projected to surface)



Co

ppm

- 8.61 - 16.41
- 16.42 - 22.16
- 22.17 - 25.41
- 25.42 - 31.43
- 31.44 - 41.58
- 41.59 - 45.89



Cr

ppm

- 68.08 - 141.00
- 141.01 - 163.00
- 163.01 - 176.00
- 176.01 - 201.61
- 201.62 - 250.00
- 250.01 - 288.46

Data Sources:

Sibbick, S., Balma, R.G., Dunn, C.E. (1996): Till Geochemistry of the Mount Milligan Area (Parts of 93N/1 & 93O/4; British Columbia Ministry of Energy, Mines and Petroleum Resources, Open File 1996-22.

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SCALE 1 : 150,000

0 5 10
kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

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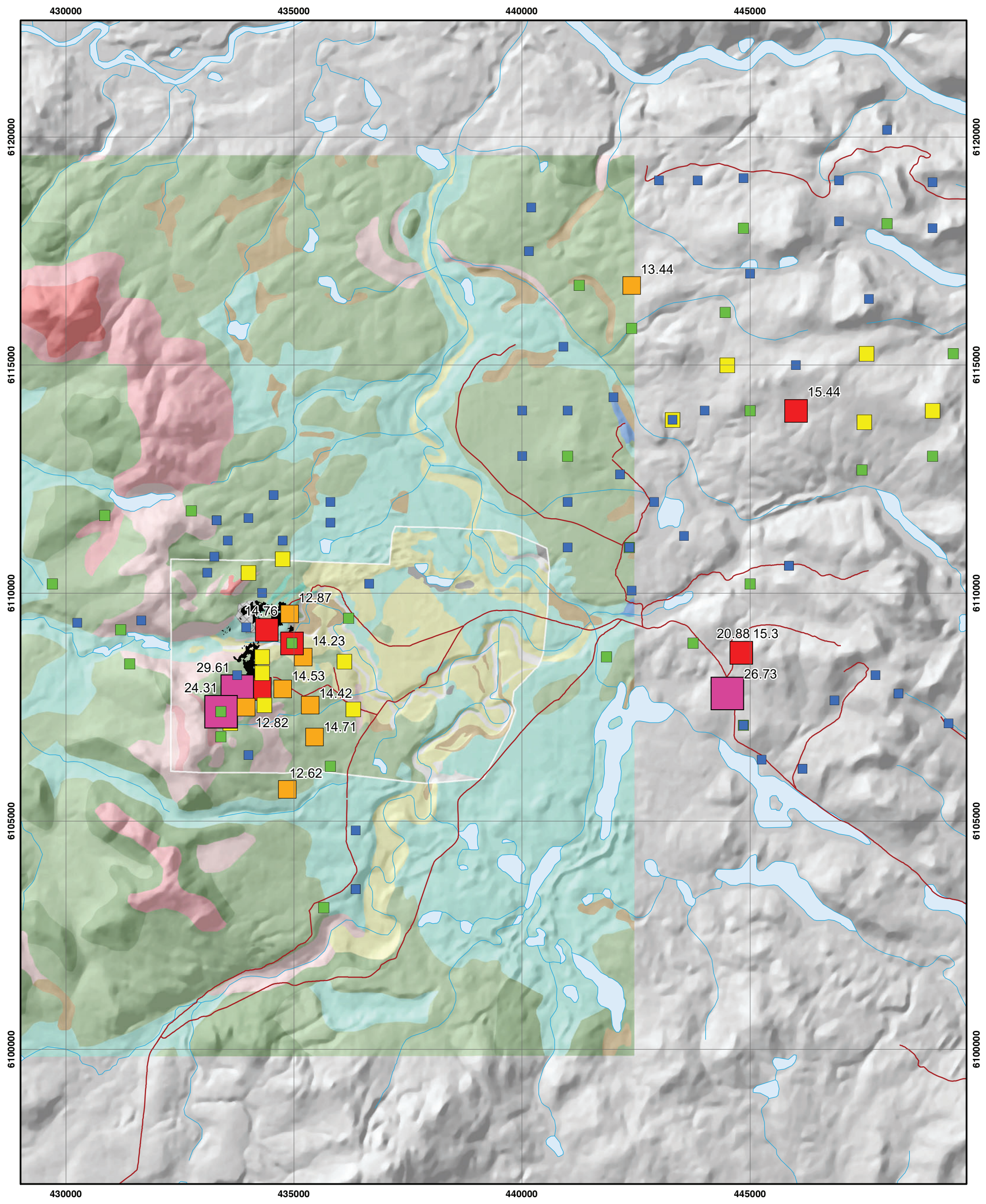
Geoscience BC

TILL
Pathfinder Elements (Base Metals)

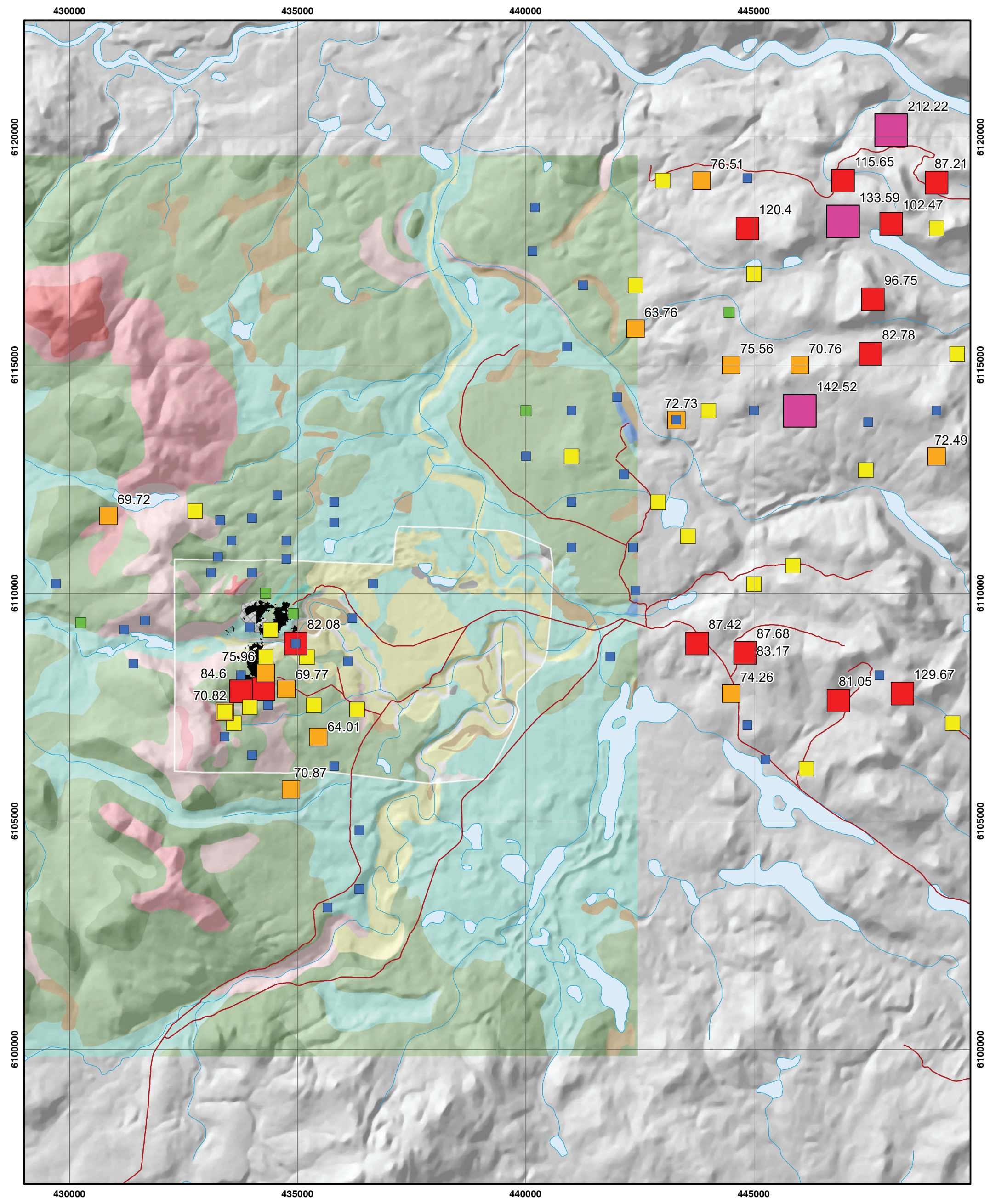
1 : 150,000



Pb

ppm

- 1.47 - 6.54
- 6.55 - 9.59
- 9.60 - 12.62
- 12.63 - 14.75
- 14.76 - 24.31
- 24.32 - 29.61



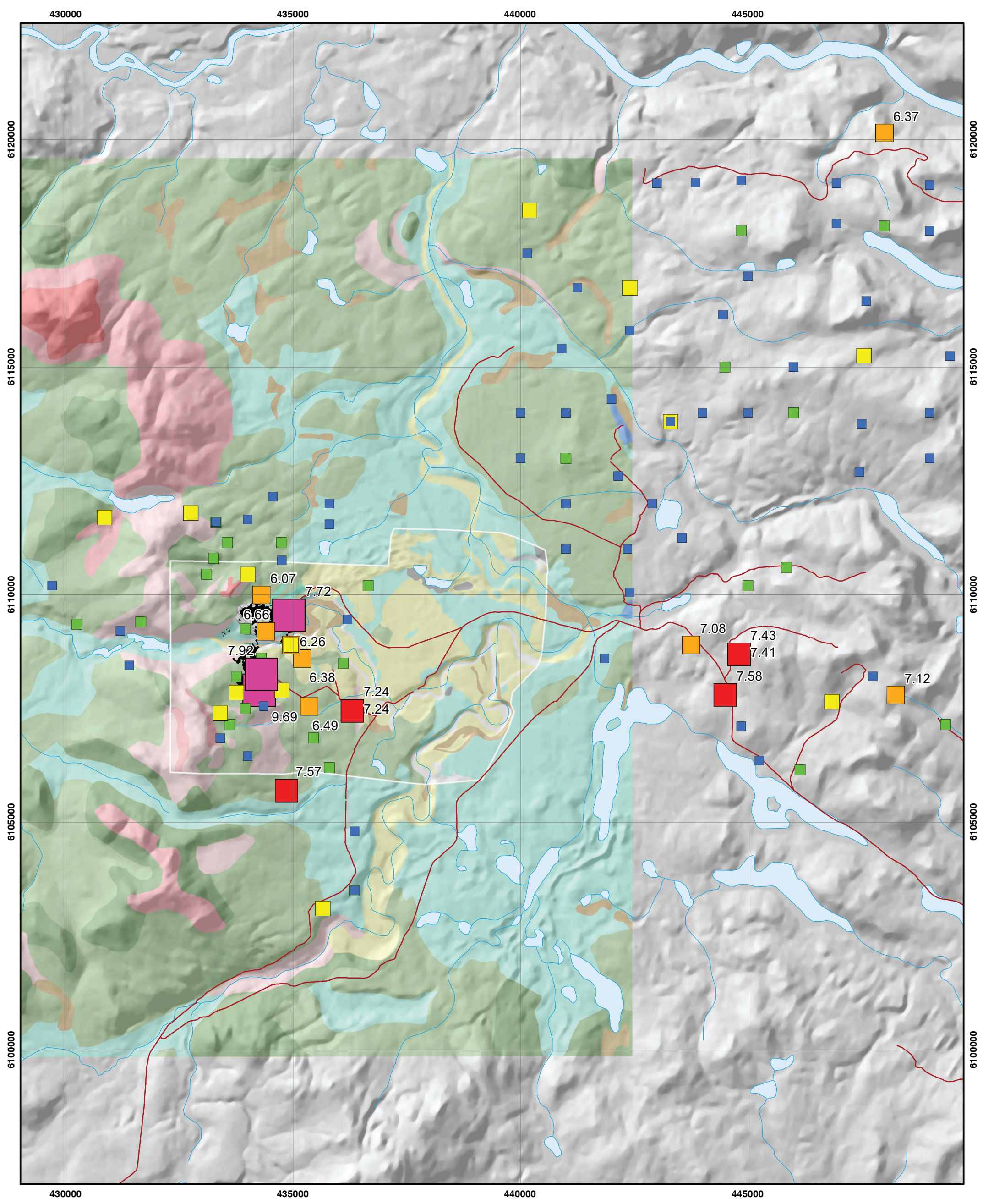
Zn

ppm

- 18.33 - 47.52
- 47.53 - 50.21
- 50.22 - 63.67
- 63.68 - 81.05
- 81.06 - 133.59
- 133.60 - 212.22

Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)

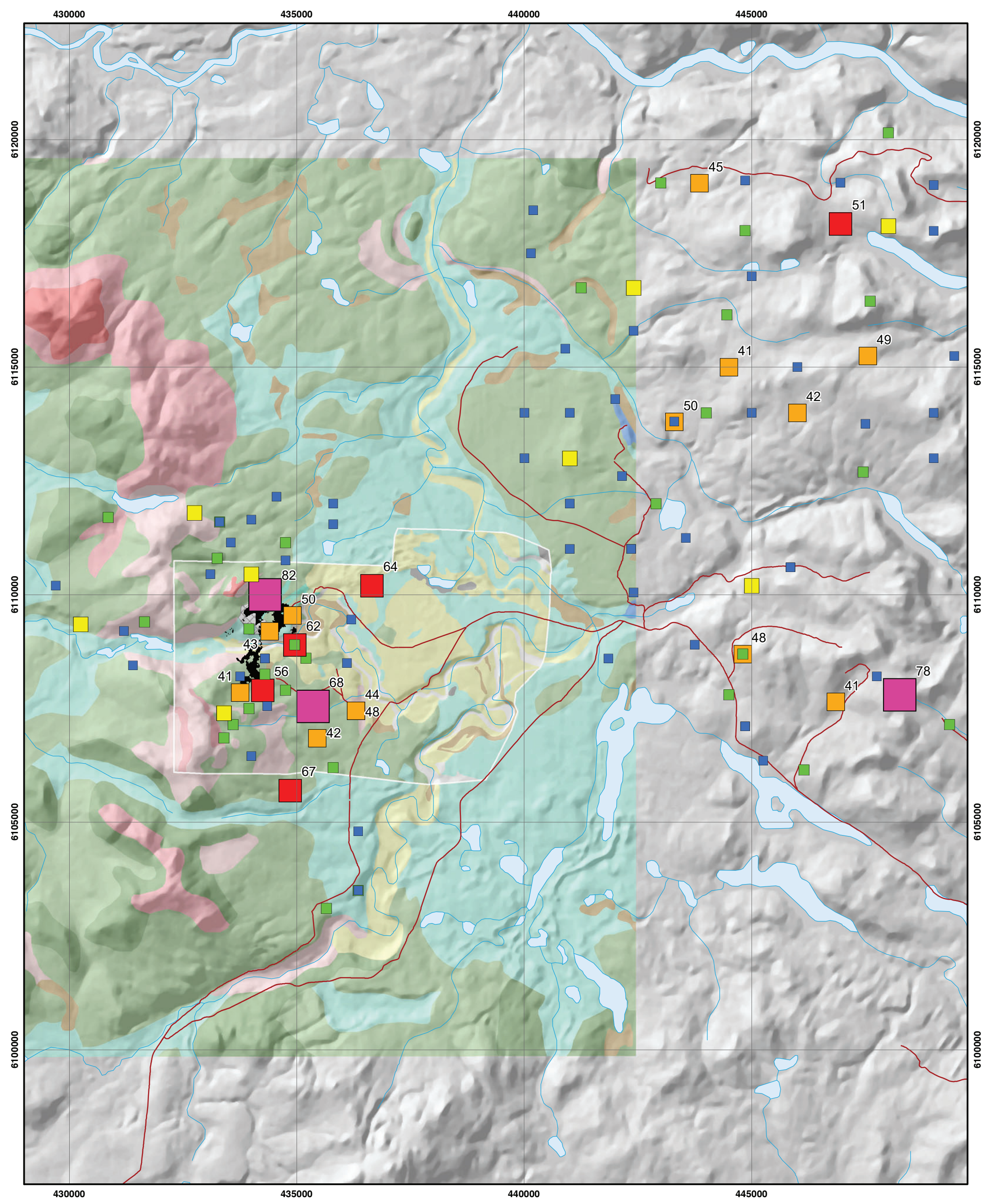
limit of
> 0.15 % Cu grade
1010 bench
(projected to surface)



Fe

percent

- 2.36 - 4.29
- 4.30 - 5.14
- 5.15 - 6.06
- 6.07 - 7.24
- 7.25 - 7.72
- 7.73 - 9.69



Ni

ppm

- 16 - 30
- 31 - 38
- 39 - 41
- 42 - 50
- 51 - 68
- 69 - 82

Data Sources:

Sibbick, S., Balma, R.G., Dunn, C.E. (1996): Till Geochemistry of the Mount Milligan Area (Parts of 93N/1 & 93O/4; British Columbia Ministry of Energy, Mines and Petroleum Resources, Open File 1996-22.

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SCALE 1 : 150,000

0 5 10
kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

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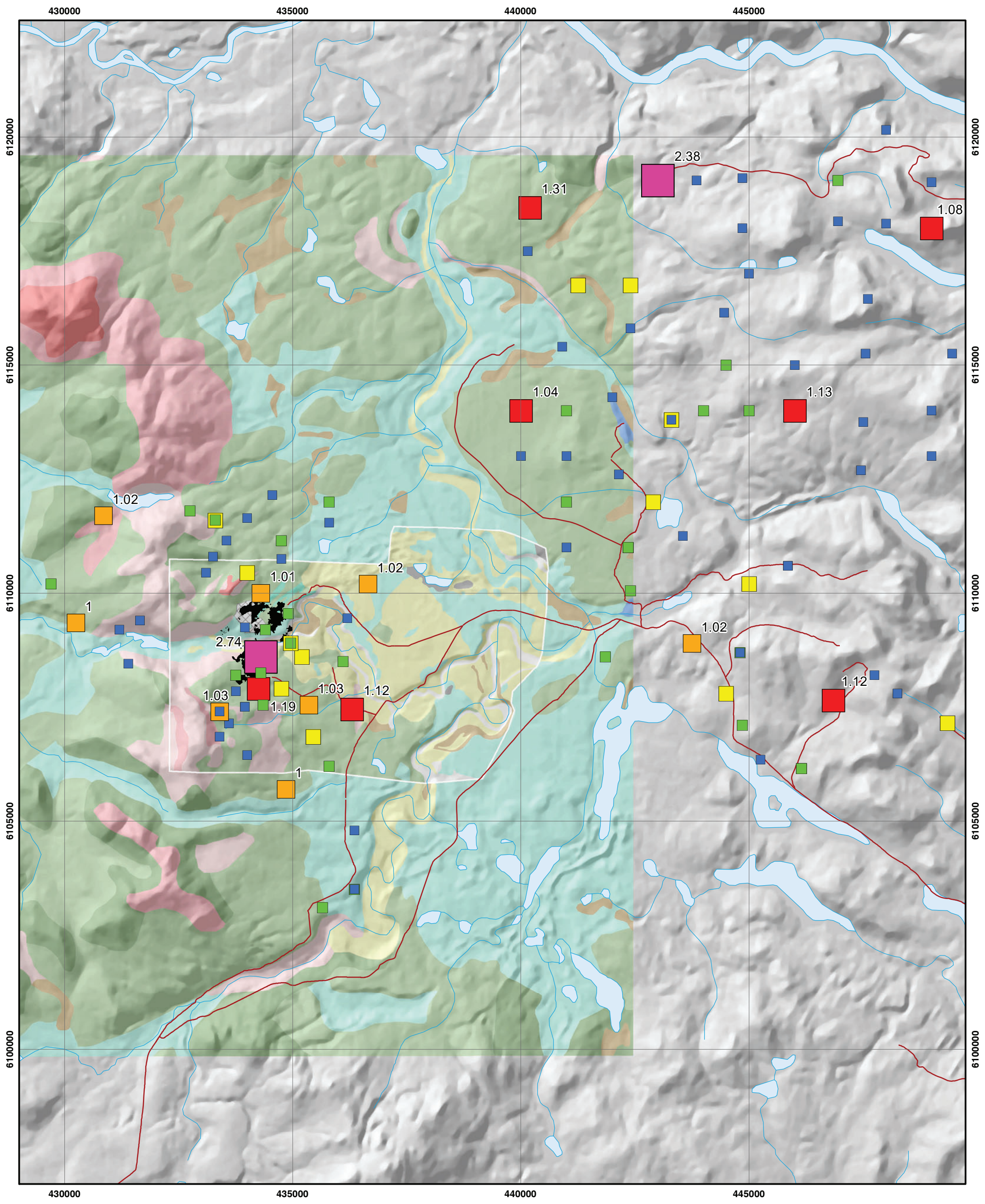
Geoscience BC

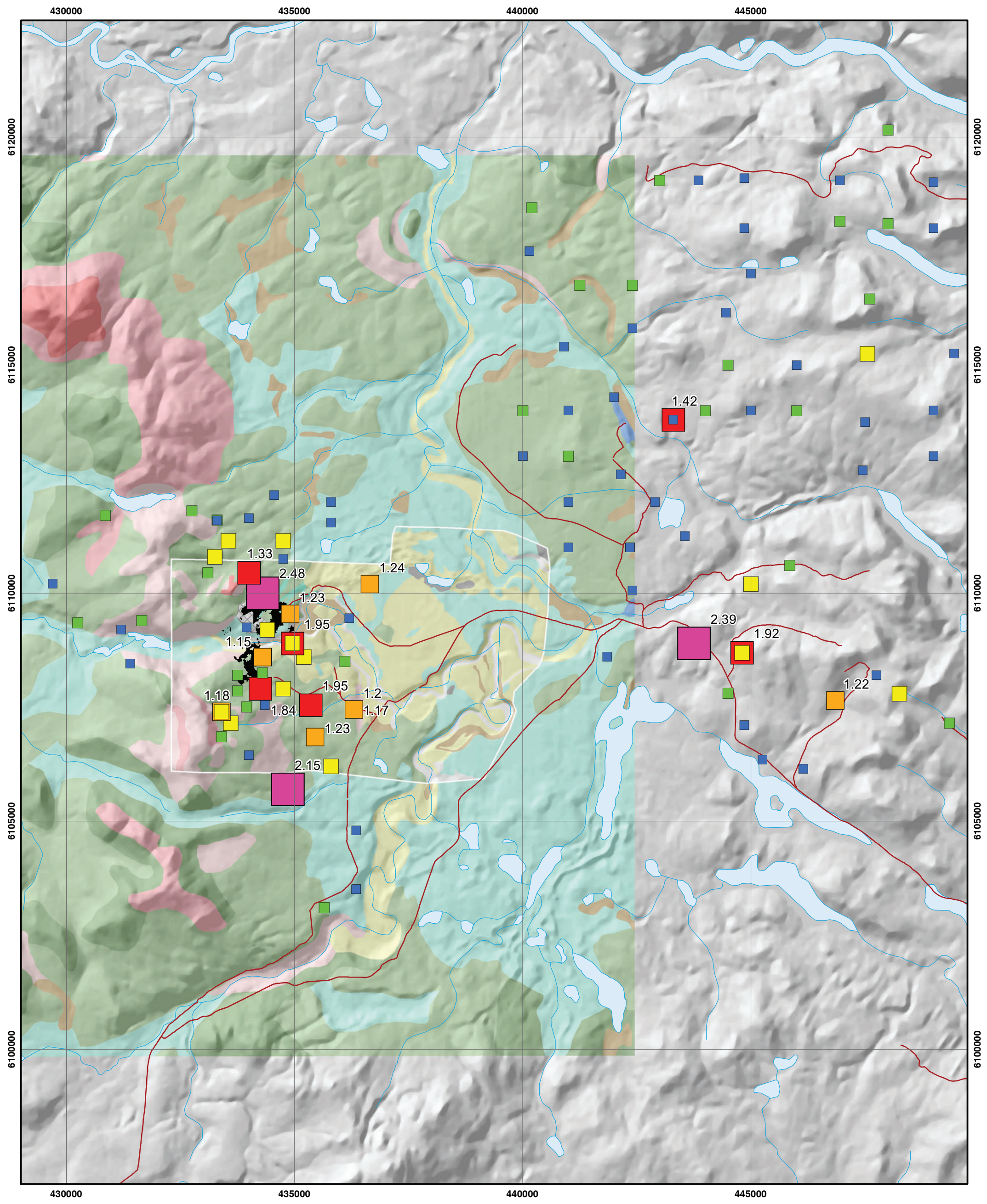
TILL
Alkaline Earth & Alkali Metals
1 : 150,000



Ca

percent

- 0.33 - 0.67
- 0.68 - 0.80
- 0.81 - 1.00
- 1.01 - 1.04
- 1.05 - 1.31
- 1.32 - 2.74



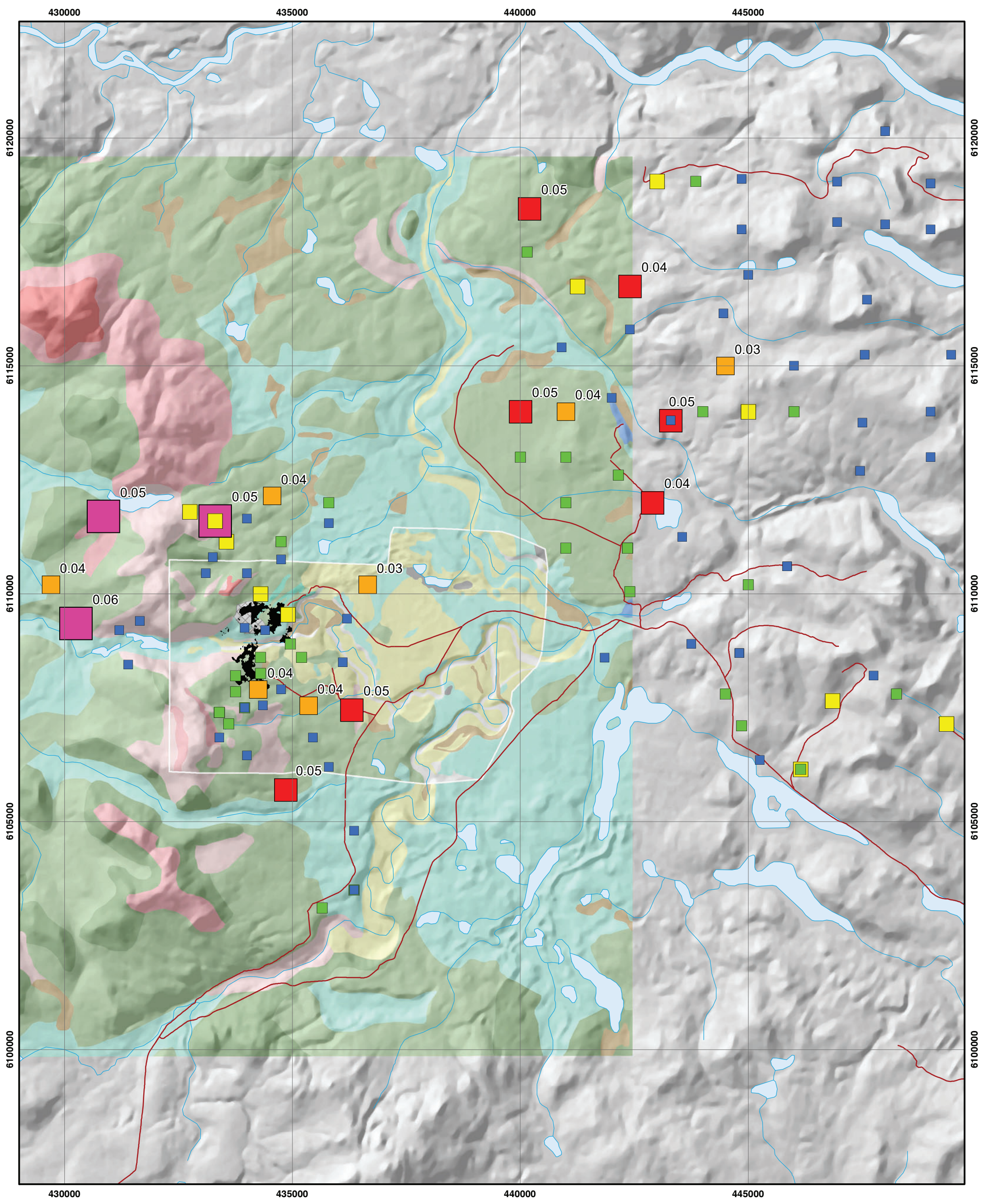
Mg

percent

- 0.03 - 0.72
- 0.73 - 0.95
- 0.96 - 1.15
- 1.16 - 1.32
- 1.33 - 2.14
- 2.15 - 2.48

Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)

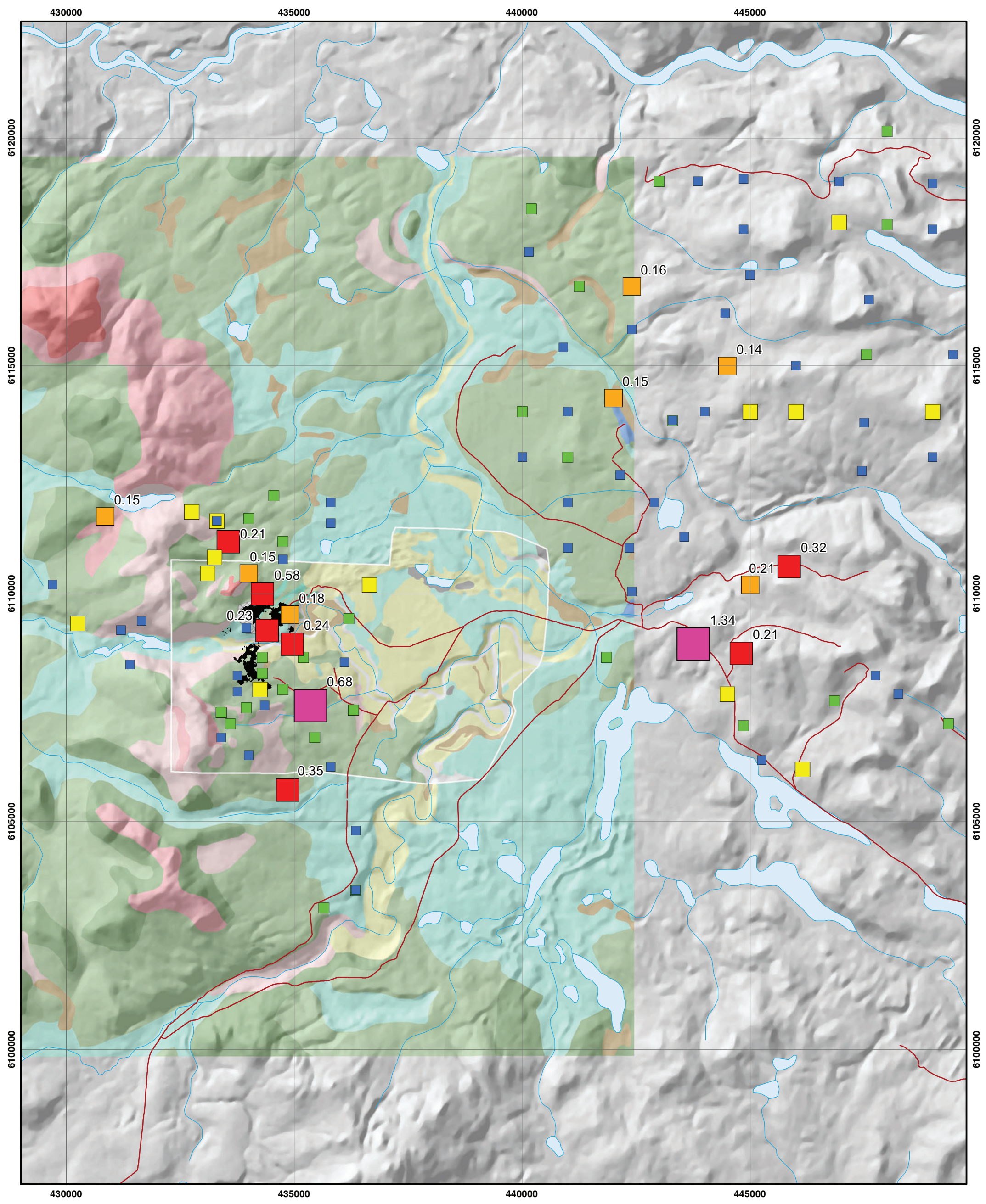
limit of
> 0.15 % Cu grade
1010 bench
(projected to surface)



Na

percent

- 0.010 - 0.020
- 0.021 - 0.030
- 0.031 - 0.040
- 0.041 - 0.050
- 0.051 - 0.060
- 0.061 - 0.061



K

percent

- 0.03 - 0.08
- 0.09 - 0.11
- 0.12 - 0.14
- 0.15 - 0.21
- 0.22 - 0.58
- 0.59 - 1.34

Data Sources:

Sibbick, S., Balma, R.G., Dunn, C.E. (1996): Till Geochemistry of the Mount Milligan Area (Parts of 93N/1 & 93O/4; British Columbia Ministry of Energy, Mines and Petroleum Resources, Open File 1996-22.

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SCALE 1 : 150,000

0 5 10
kilometres

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Porphyry Districts of British Columbia Atlas Series

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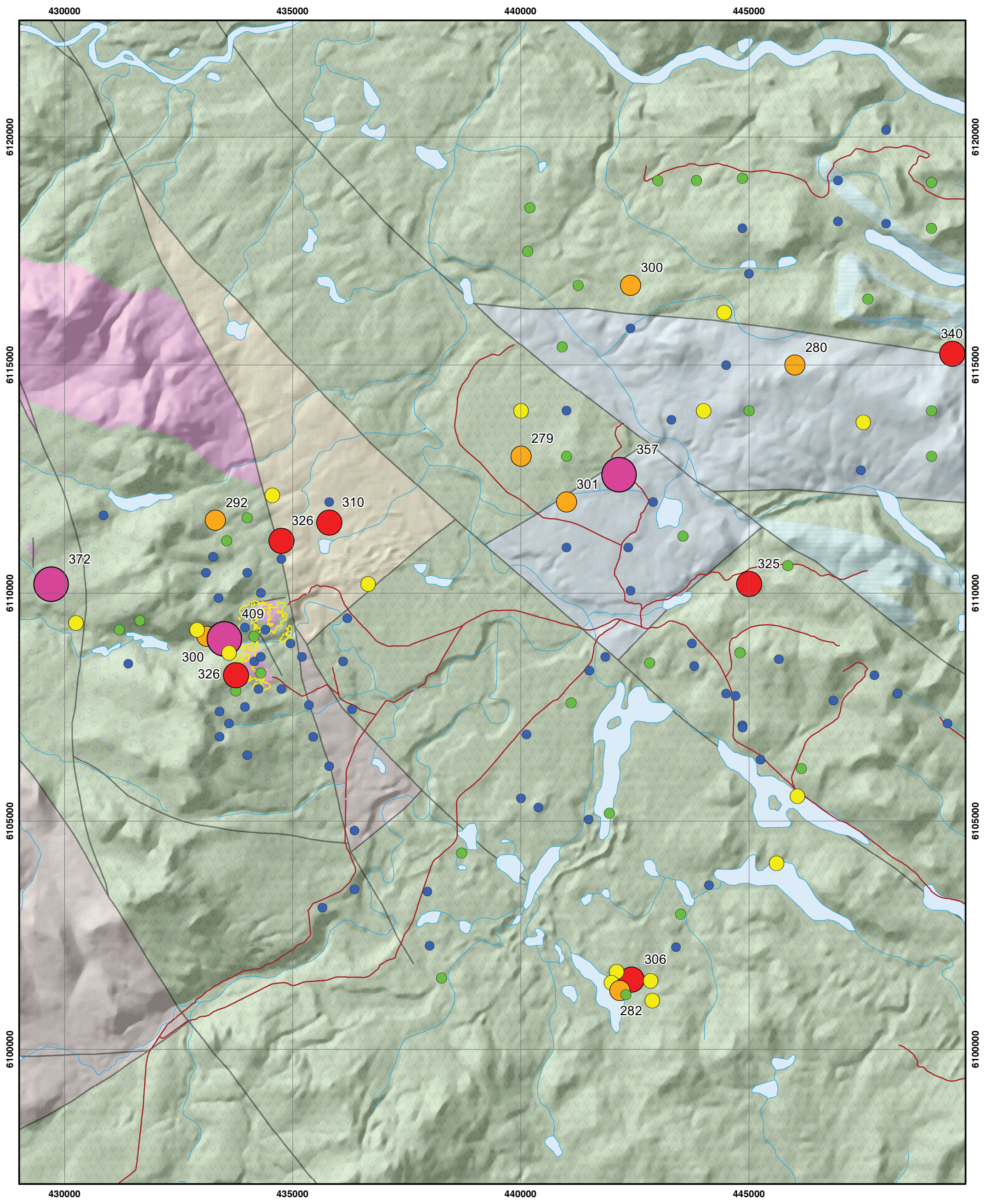
Geoscience BC

BIOGEOCHEMISTRY
Lodegepole pine bark (ashed)

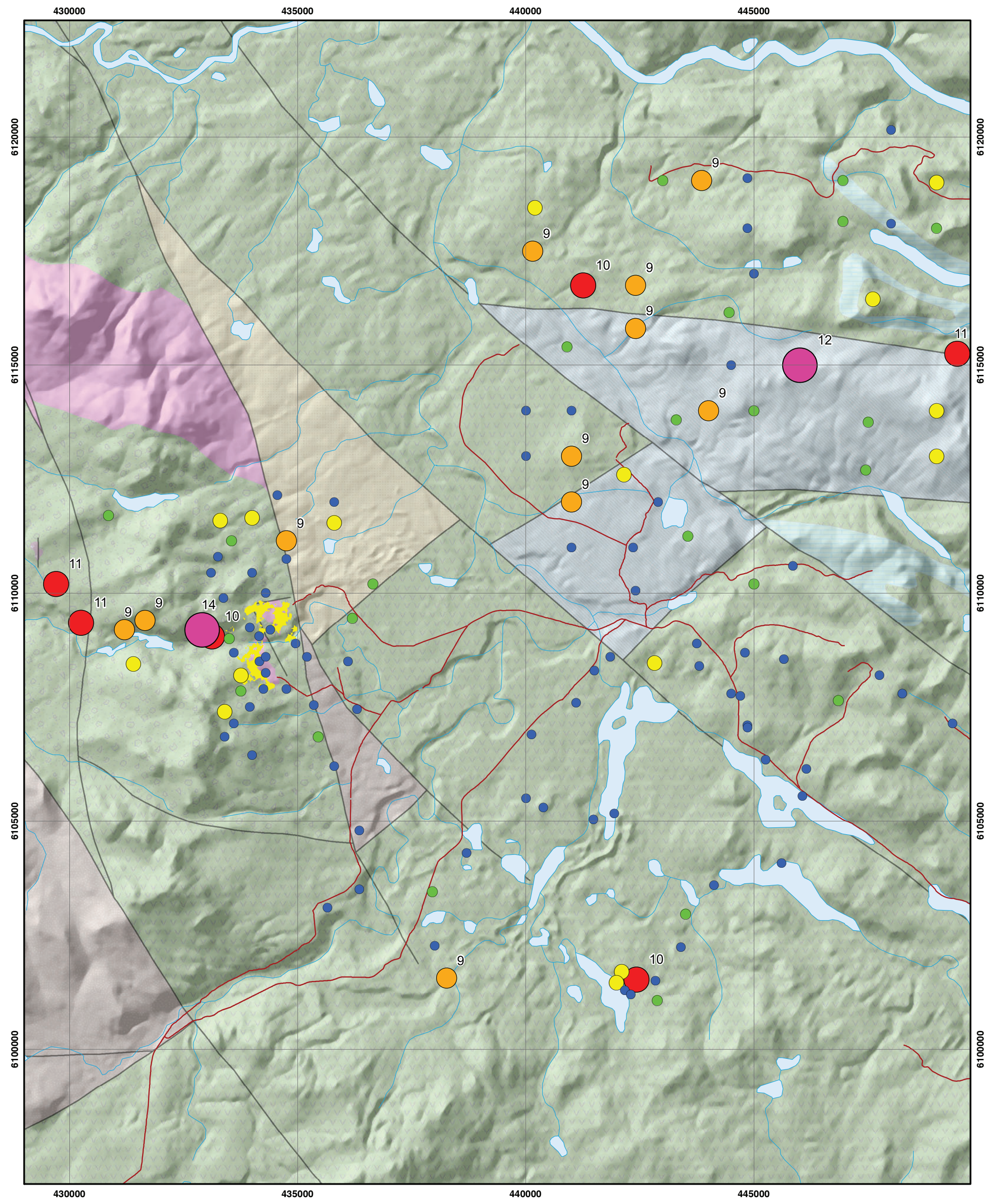
1 : 150,000



Cu

ppm

- 0 - 173
- 174 - 233
- 234 - 277
- 278 - 301
- 302 - 340
- 341 - 409



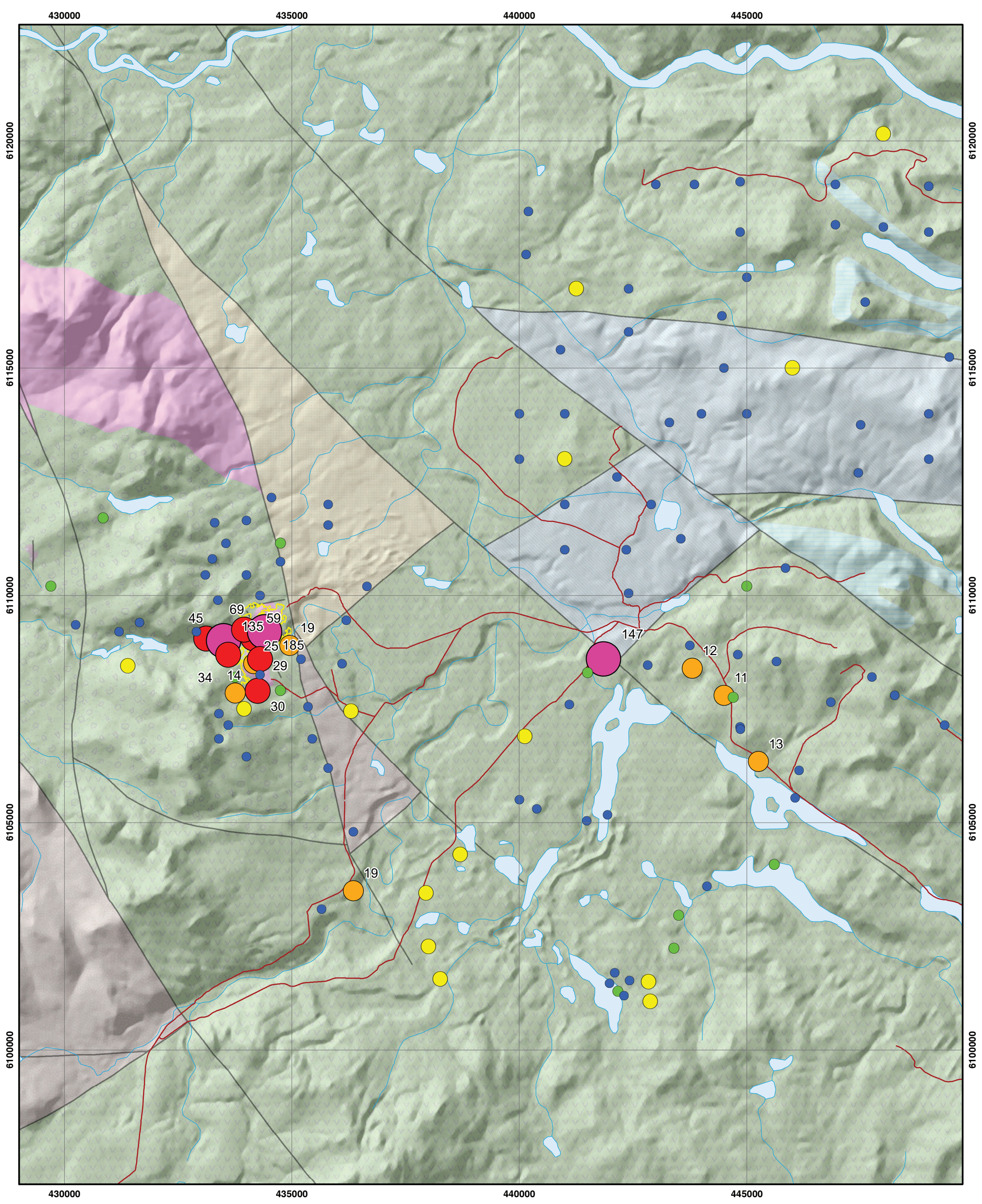
Mo

ppm

- 0 - 4
- 5 - 6
- 7 - 8
- 9
- 10 - 11
- 12 - 14

Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)

limit of
> 0.15 % Cu grade
1010 bench (metres a.s.l.)
(projected to surface)



Au

ppb

- 2.5
- 2.6 - 6.0
- 6.1 - 9.0
- 9.1 - 25.0
- 25.1 - 69.0
- 69.1 - 185.0

These data were published by Dunn et al. (1996) as a compilation of samples collected during three survey efforts in 1991 and 1995. Samples of scales of outer bark from lodgepole pine were processed to ash under controlled ignition, resulting in a concentration of elements in the ash and little loss except for elements of high volatility.

Element concentrations in the ash were determined using instrumental neutron activation analysis (INAA) for 36 elements, 27 of which were found to be detectable. In addition inductively-coupled plasma emission spectrometry (ICP-ES) was used to determine data for 12 elements.

Data Sources:

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0 5 10

kilometres

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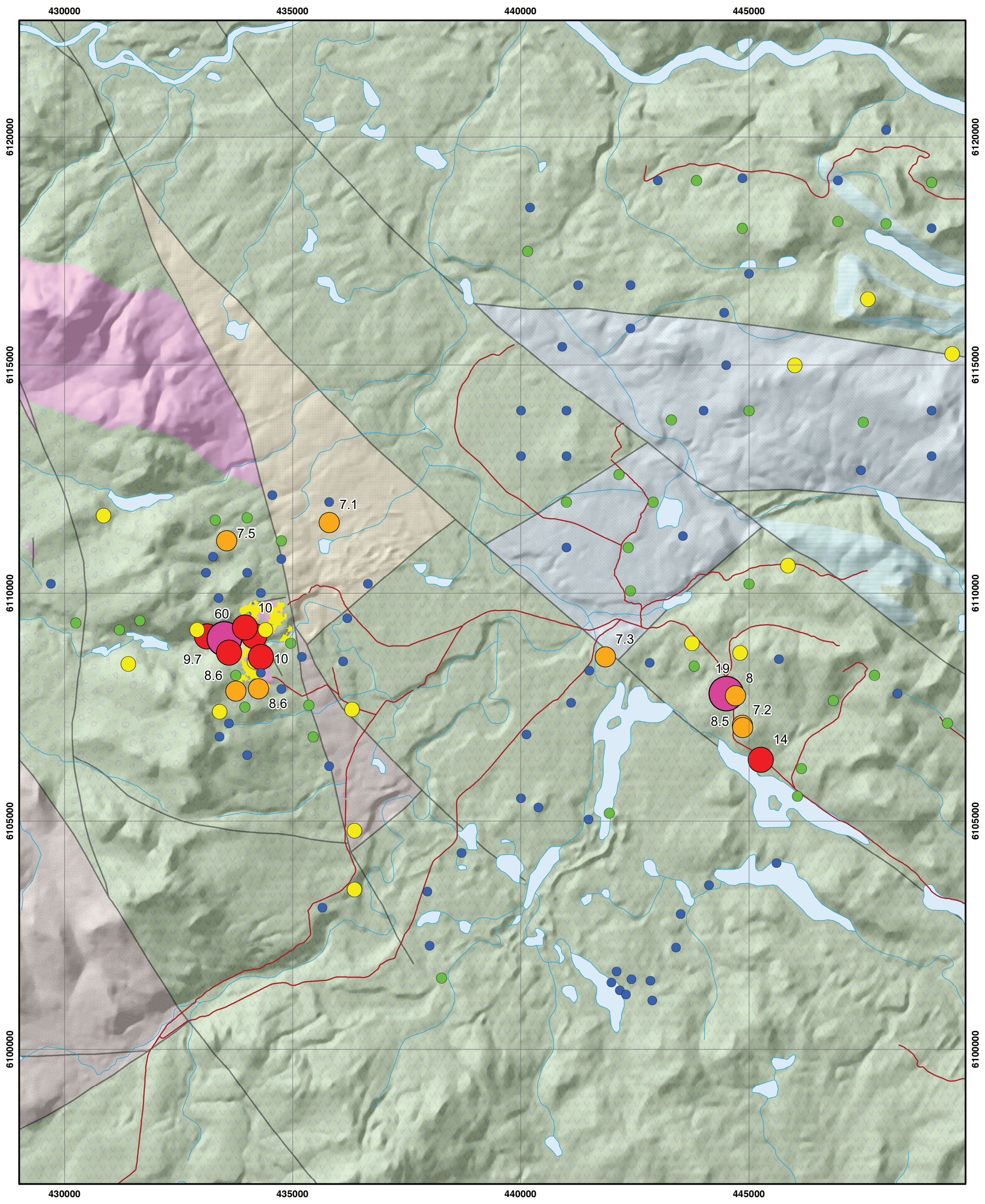
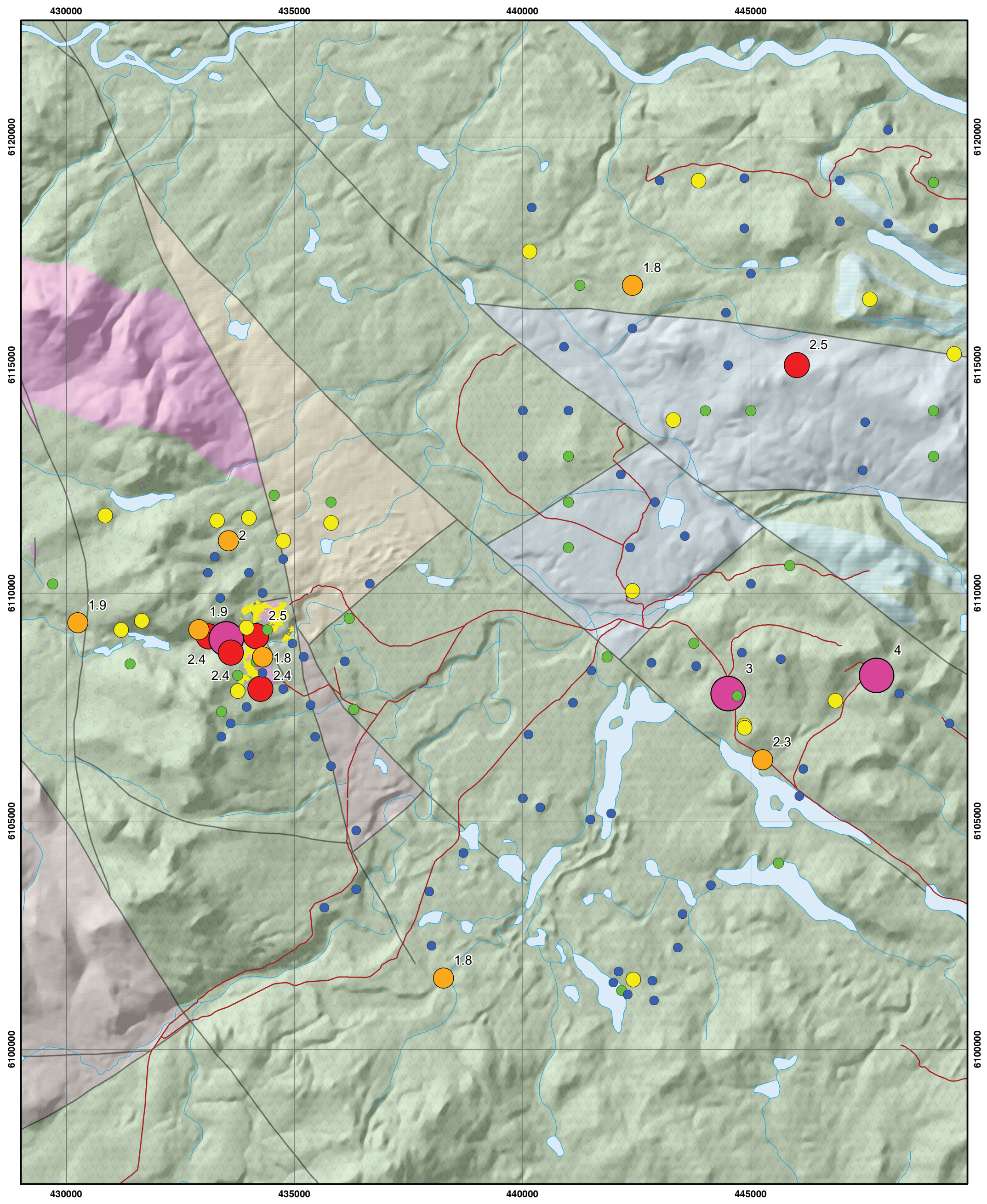
1 : 150,000



As

ppm

- 0.7 - 3.2
- 3.3 - 4.8
- 4.9 - 6.9
- 7.0 - 8.6
- 8.7 - 14.0
- 14.1 - 60.0



Sb

ppm

- 0.2 - 1.1
- 1.2 - 1.4
- 1.5 - 1.7
- 1.8 - 2.3
- 2.4 - 2.9
- 3.0 - 5.0

Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)

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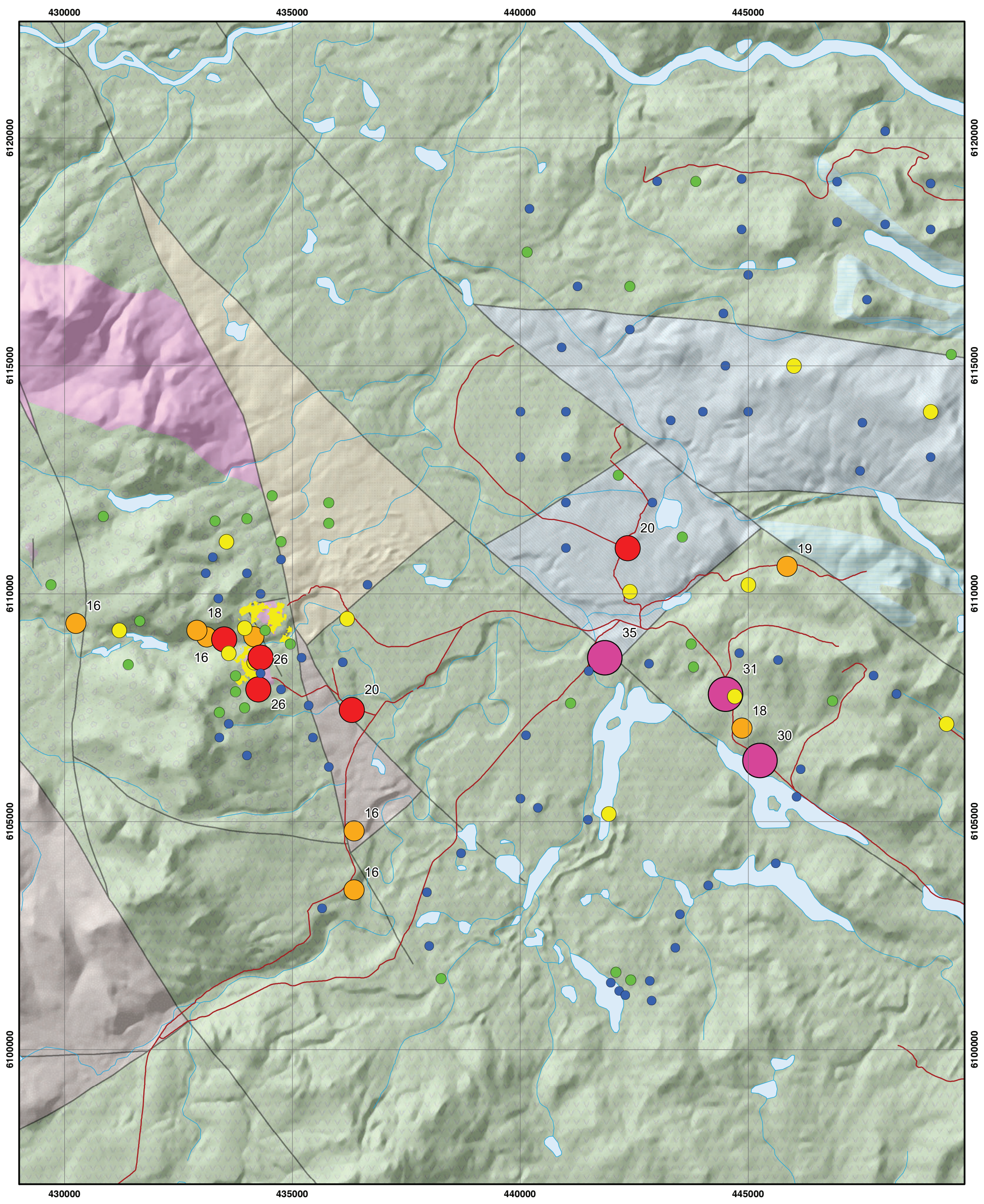
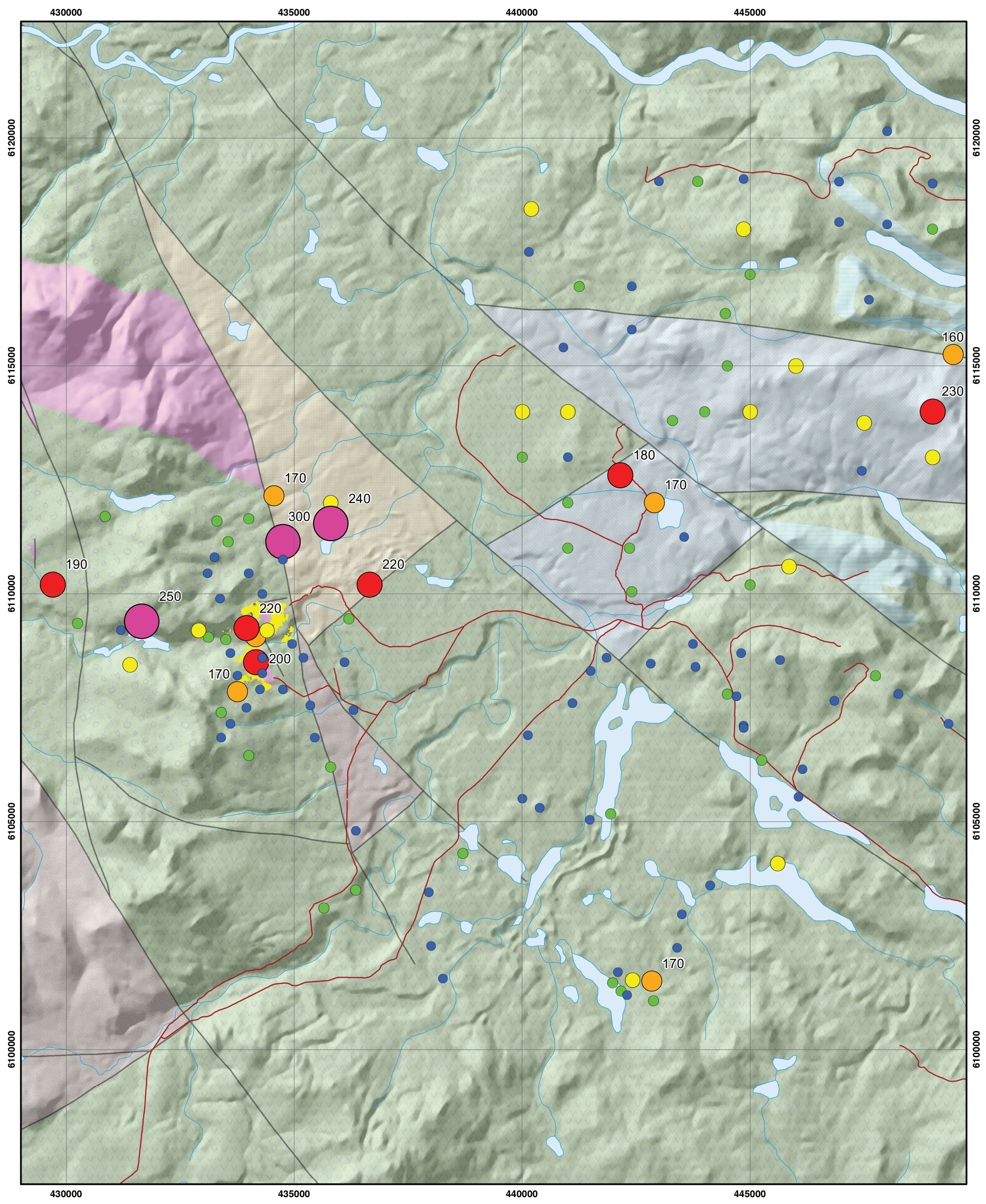


Ce

ppm

- 2 - 7
- 8 - 11
- 12 - 15
- 16 - 19
- 20 - 26
- 27 - 35



Rb

ppm

- 3 - 78
- 79 - 100
- 101 - 150
- 151 - 170
- 171 - 230
- 231 - 300

Data Sources:

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SCALE 1 : 150,000

0 5 10
kilometres

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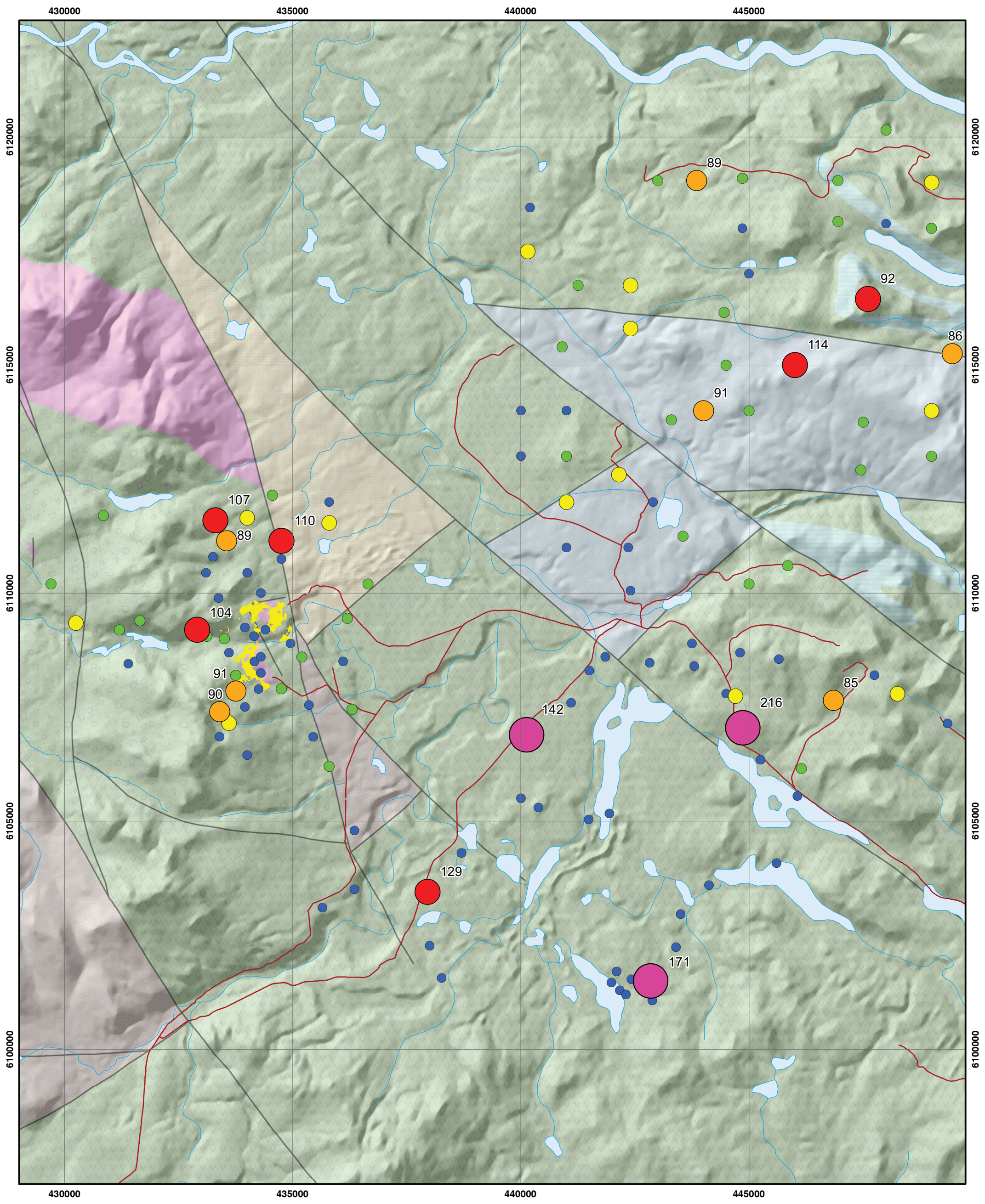
BIOGEOCHEMISTRY
Lodegepole pine bark (ashed)

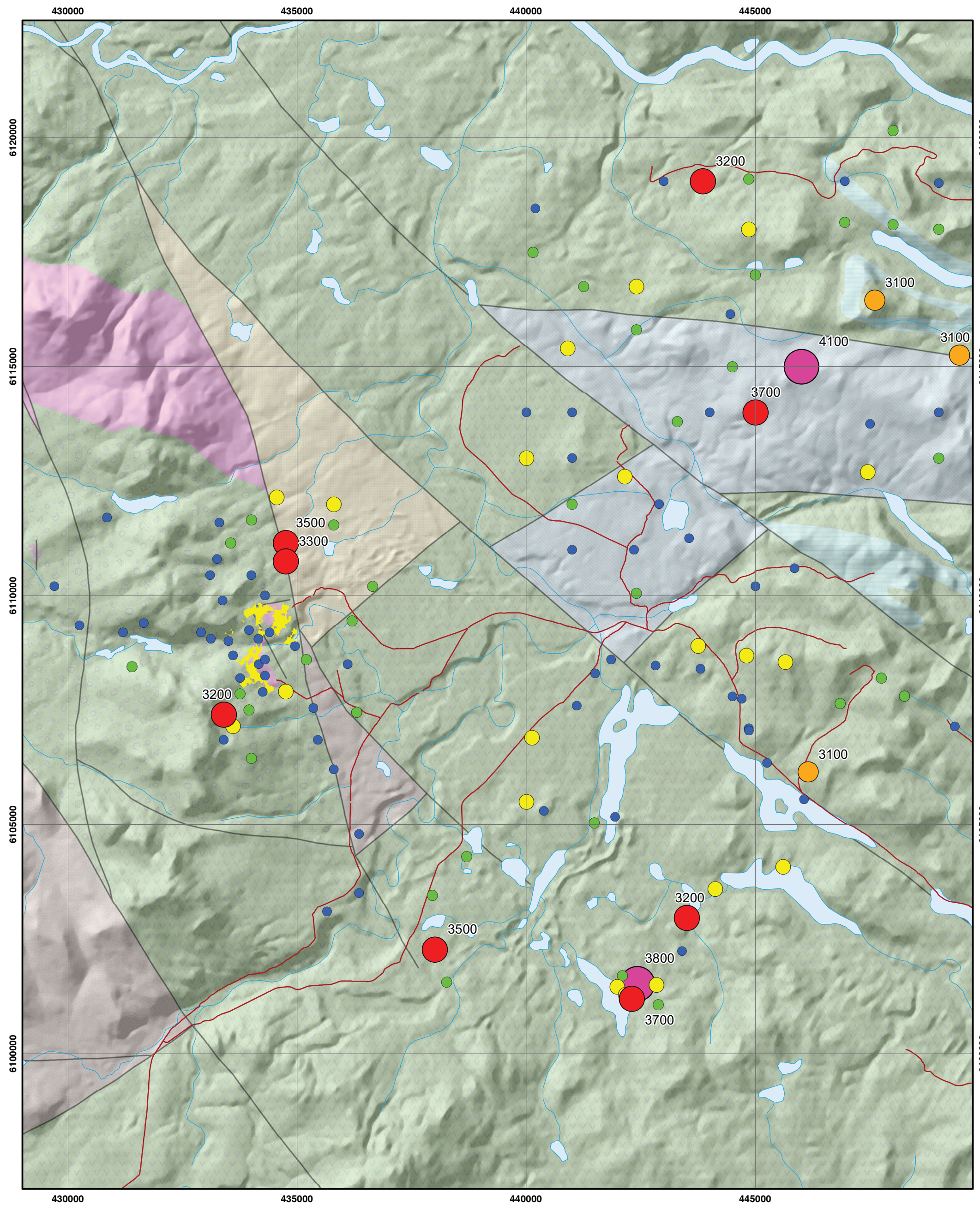
1 : 150,000



Pb

ppm

- 0 - 54
- 55 - 73
- 74 - 84
- 85 - 91
- 92 - 129
- 130 - 216



Zn

ppm

- 420 - 2200
- 2201 - 2700
- 2701 - 3000
- 3001 - 3100
- 3101 - 3700
- 3701 - 4100

Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)

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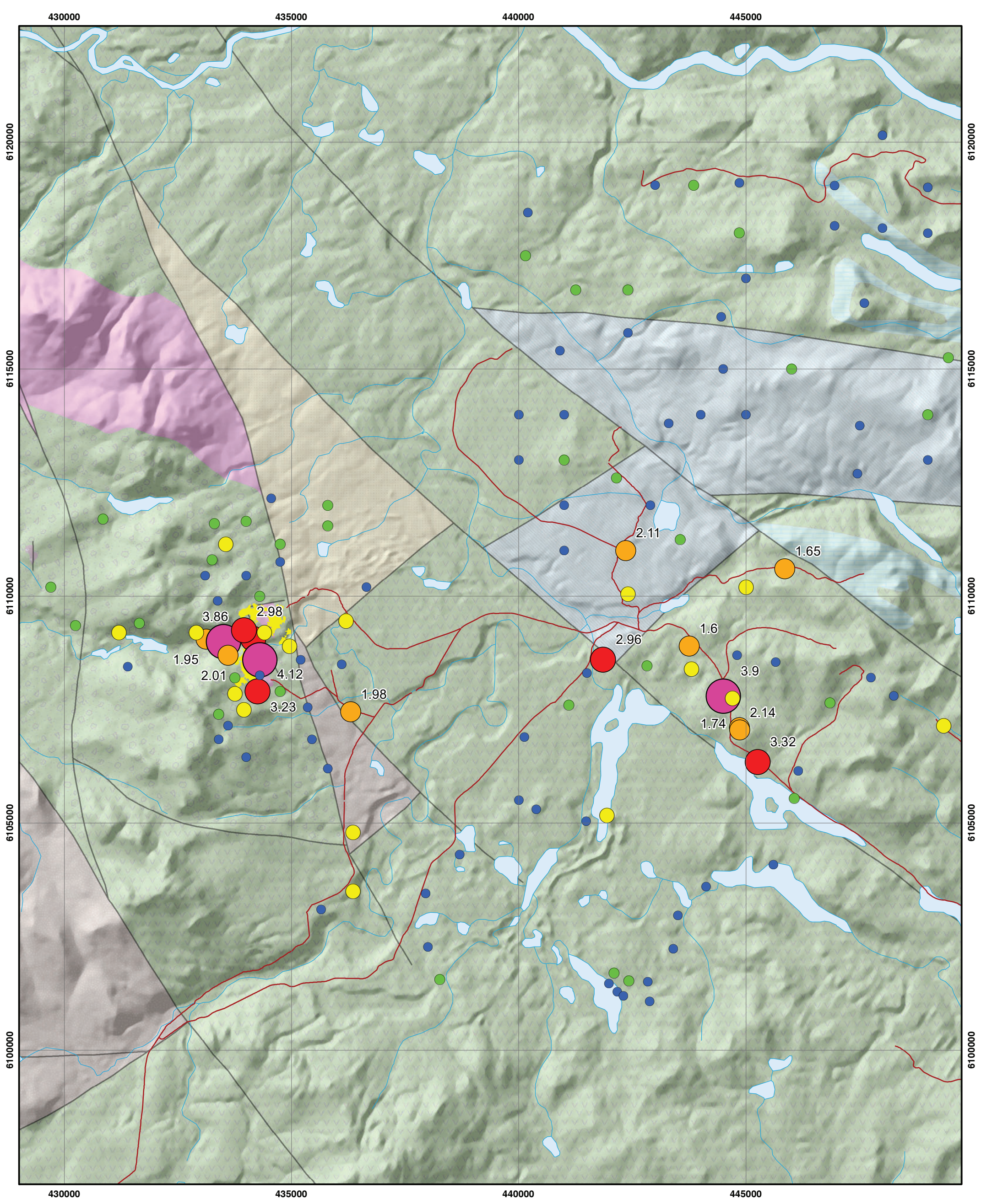
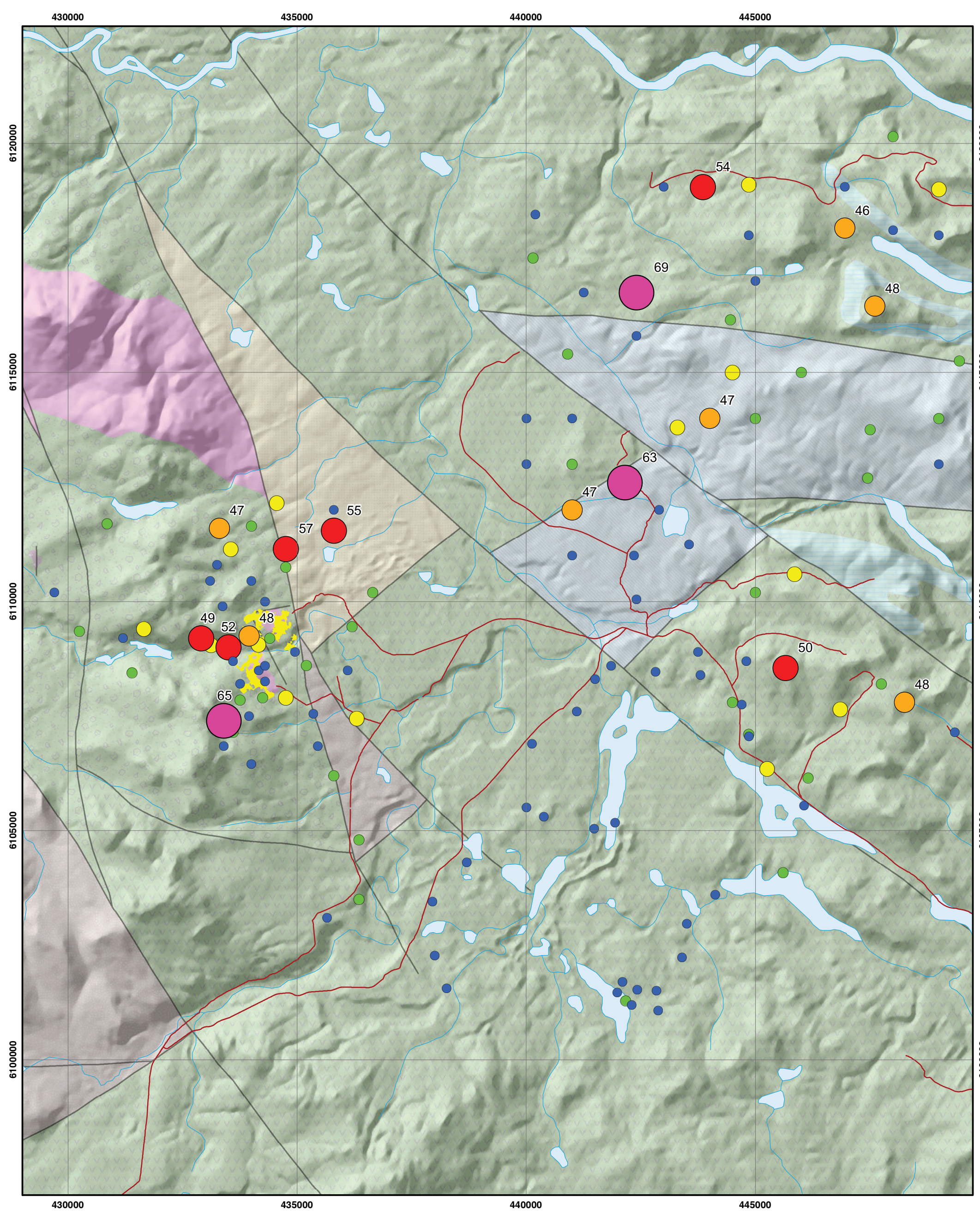
1010 bench (metres a.s.l.)
(projected to surface)



Fe

percent

- 0.14 - 0.53
- 0.54 - 0.99
- 1.00 - 1.59
- 1.60 - 2.14
- 2.15 - 3.32
- 3.33 - 4.12



Ni

ppm

- 0 - 27
- 28 - 36
- 37 - 45
- 46 - 48
- 49 - 57
- 58 - 69

Data Sources:

Dunn, C.E., Balma, R.G., Sibbick, S.J. (1996): Distribution of 40 elements derived from pine bark at 134 sites (GSC OF 3290) and 29 elements derived from till at 108 sites (GSC OF 3291) near the Mount Milligan copper-gold deposit in central British Colmbia, *in* S.Williams, B. Ballantyne R. Balma, K. Bellefontaine, C. Dunn, F. Ferri, J. Grant, A. Plouffe, R. Shives, S. Sibbick, B. Struik (1996): Quesnel Trough: a digital suite of geoscience information; BCGS Open File 1996-17.

SCALE 1 : 150,000

0 5 10
kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

Porphyry Districts of British Columbia Atlas Series

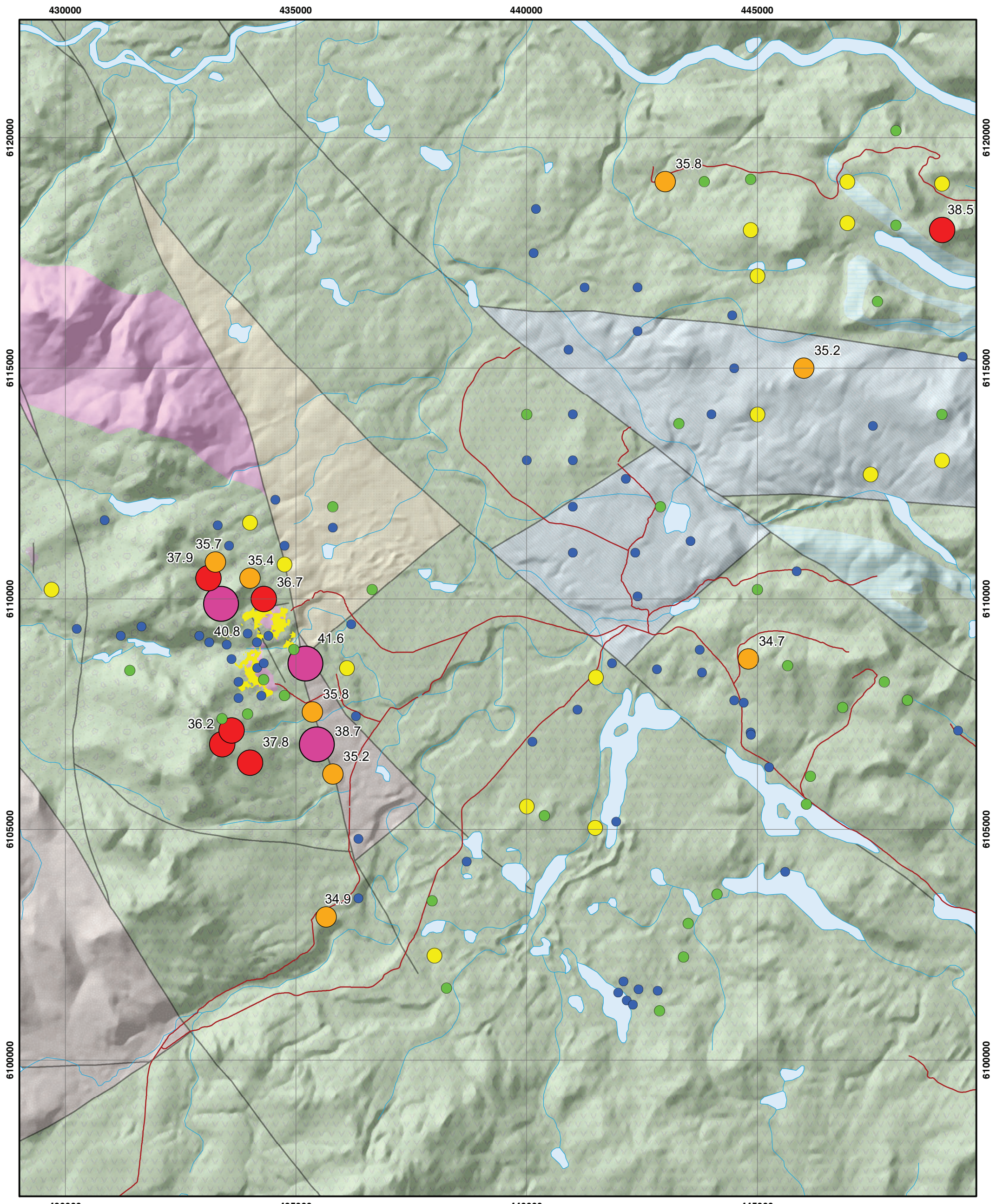
MT. MILLIGAN

A geo-exploration atlas of the Mt. Milligan porphyry copper-gold district

Geoscience BC

BIOGEOCHEMISTRY
Lodegepole pine bark (ashed)

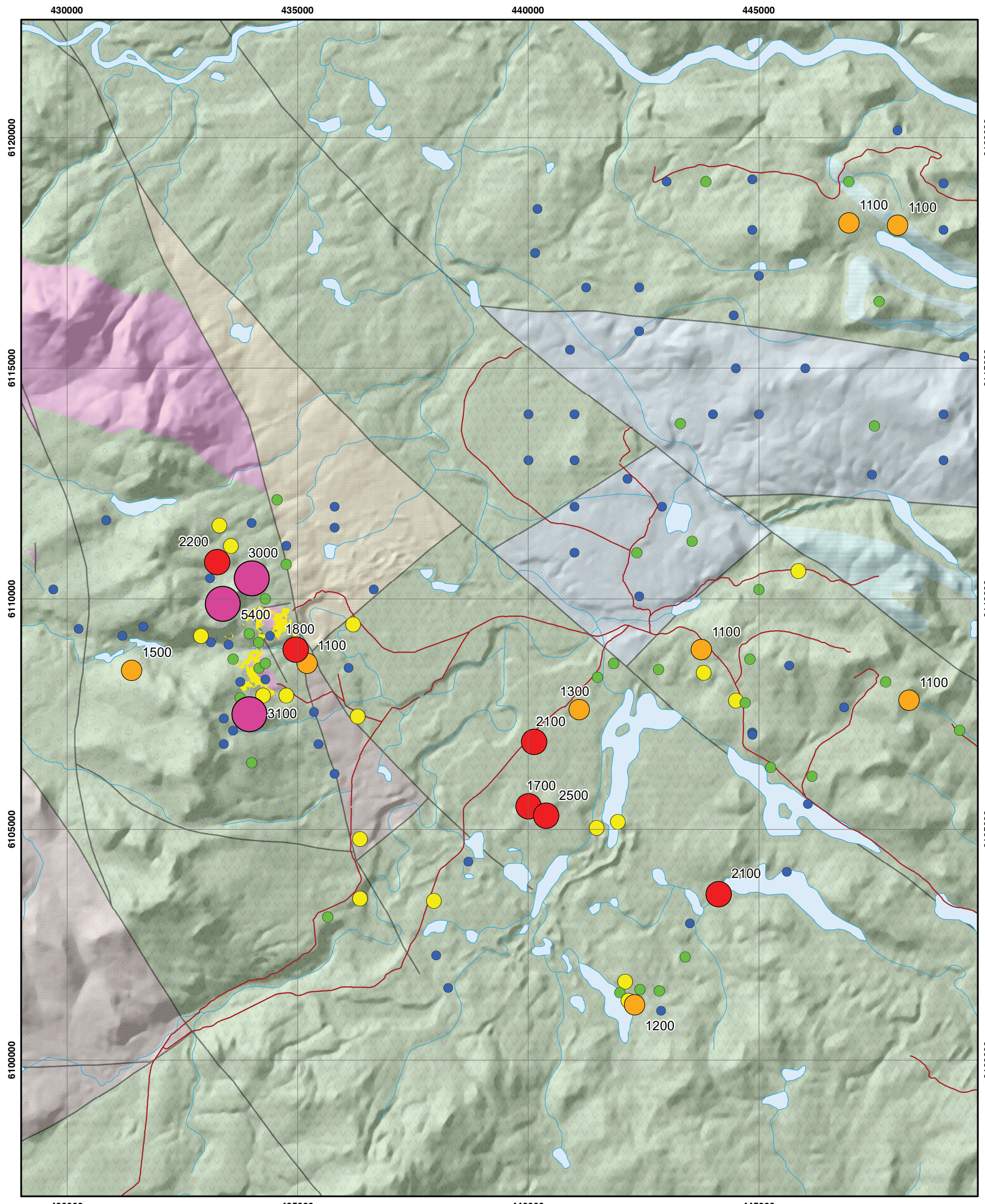
1 : 150,000



Ca

percent

- 5.2 - 29.0
- 29.1 - 32.0
- 32.1 - 34.6
- 34.7 - 35.8
- 35.9 - 38.5
- 38.6 - 41.6



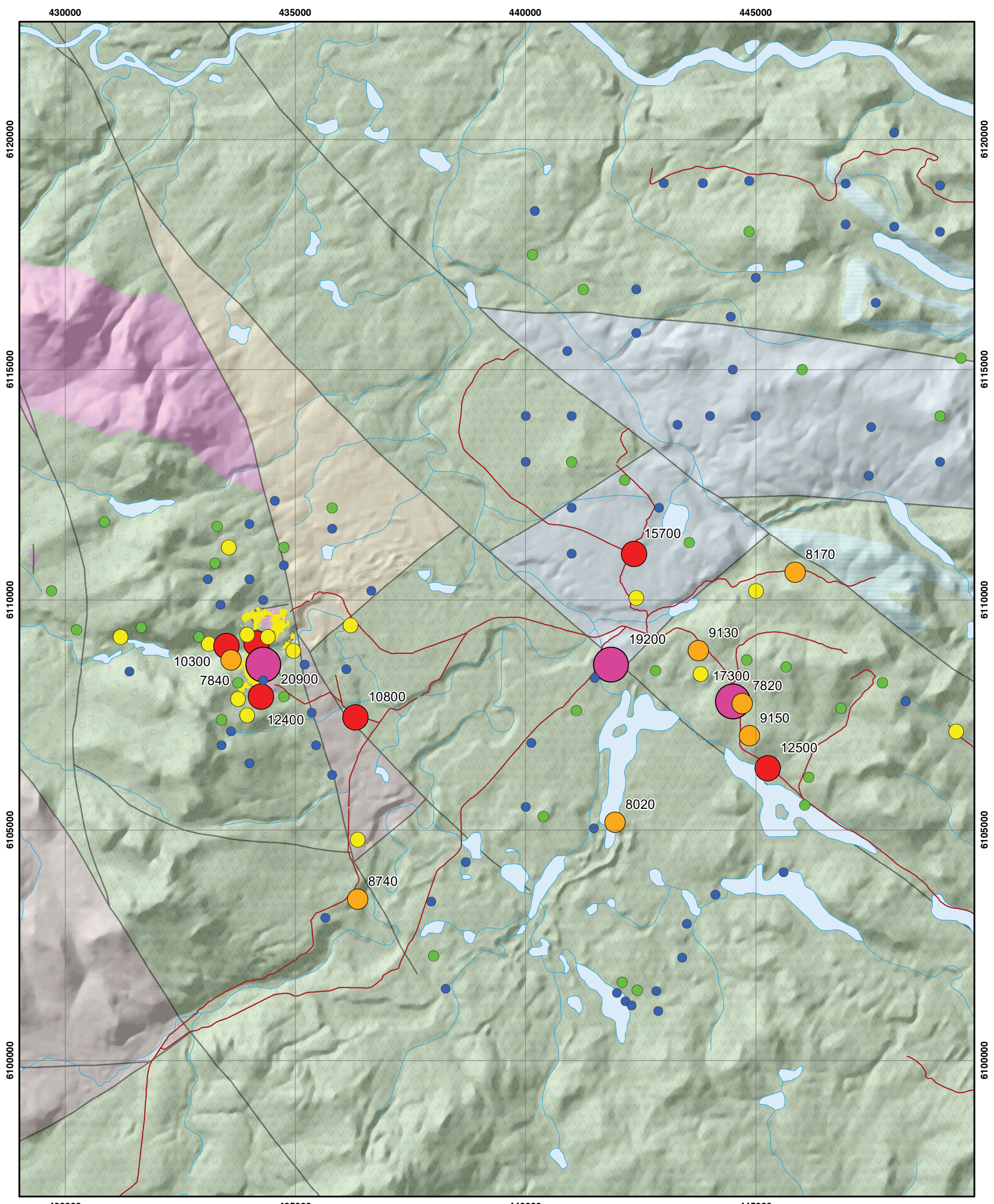
Ba

ppm

- 150.0 - 580.0
- 580.1 - 760.0
- 760.1 - 1000.0
- 1000.1 - 1500.0
- 1500.1 - 2500.0
- 2500.1 - 5400.0

Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)

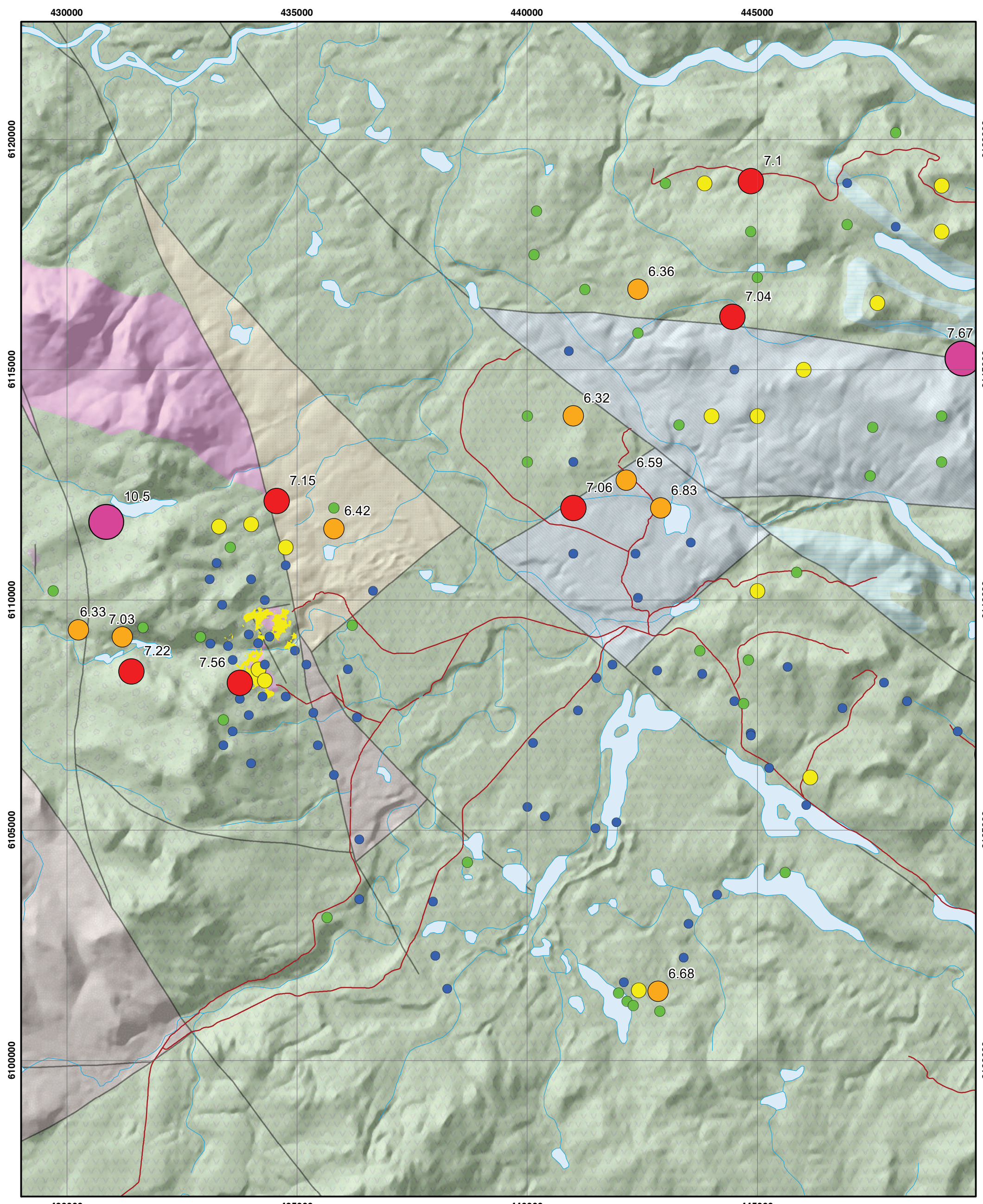
limit of
> 0.15 % Cu grade
1010 bench (metres a.s.l.)
(projected to surface)



Na

ppm

- 595.0 - 2380.0
- 2380.1 - 4830.0
- 4830.1 - 7730.0
- 7730.1 - 9150.0
- 9150.1 - 15700.0
- 15700.1 - 20900.0



K

percent

- 0.70 - 4.15
- 4.16 - 5.22
- 5.23 - 6.23
- 6.24 - 7.03
- 7.04 - 7.56
- 7.57 - 10.50

Data Sources:

Dunn, C.E., Balma, R.G., Sibbick, S.J. (1996): Distribution of 40 elements derived from pine bark at 134 sites (GSC OF 3290) and 29 elements derived from till at 108 sites (GSC OF 3291) near the Mount Milligan copper-gold deposit in central British Colmbia, *in* S.Williams, B. Ballantyne R. Balma, K. Bellefontaine, C. Dunn, F. Ferri, J. Grant, A. Plouffe, R. Shives, S. Sibbick, B. Struik (1996): Quesnel Trough: a digital suite of geoscience information; BCGS Open File 1996-17.

SCALE 1 : 150,000

0 5 10
kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

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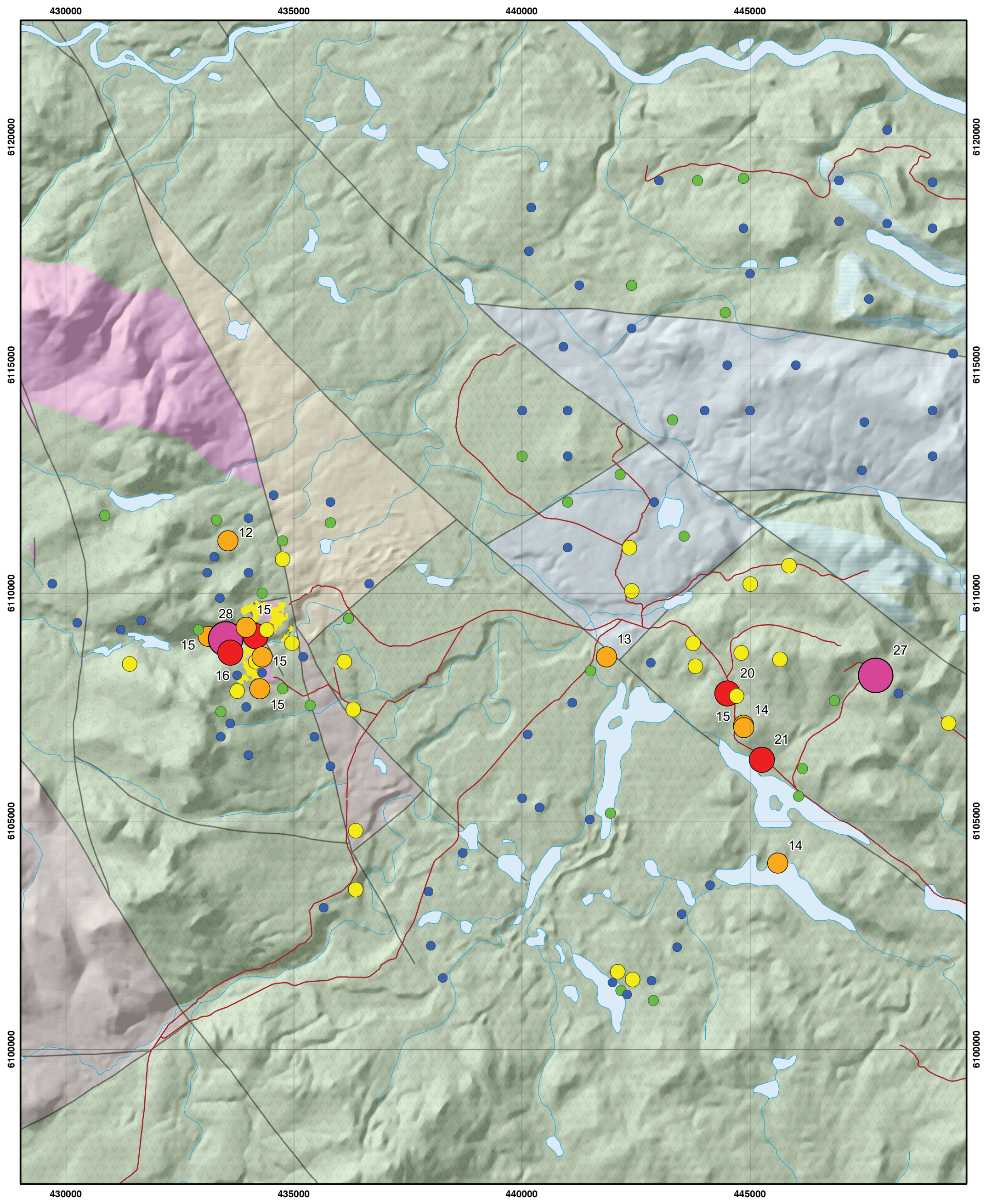
Geoscience BC

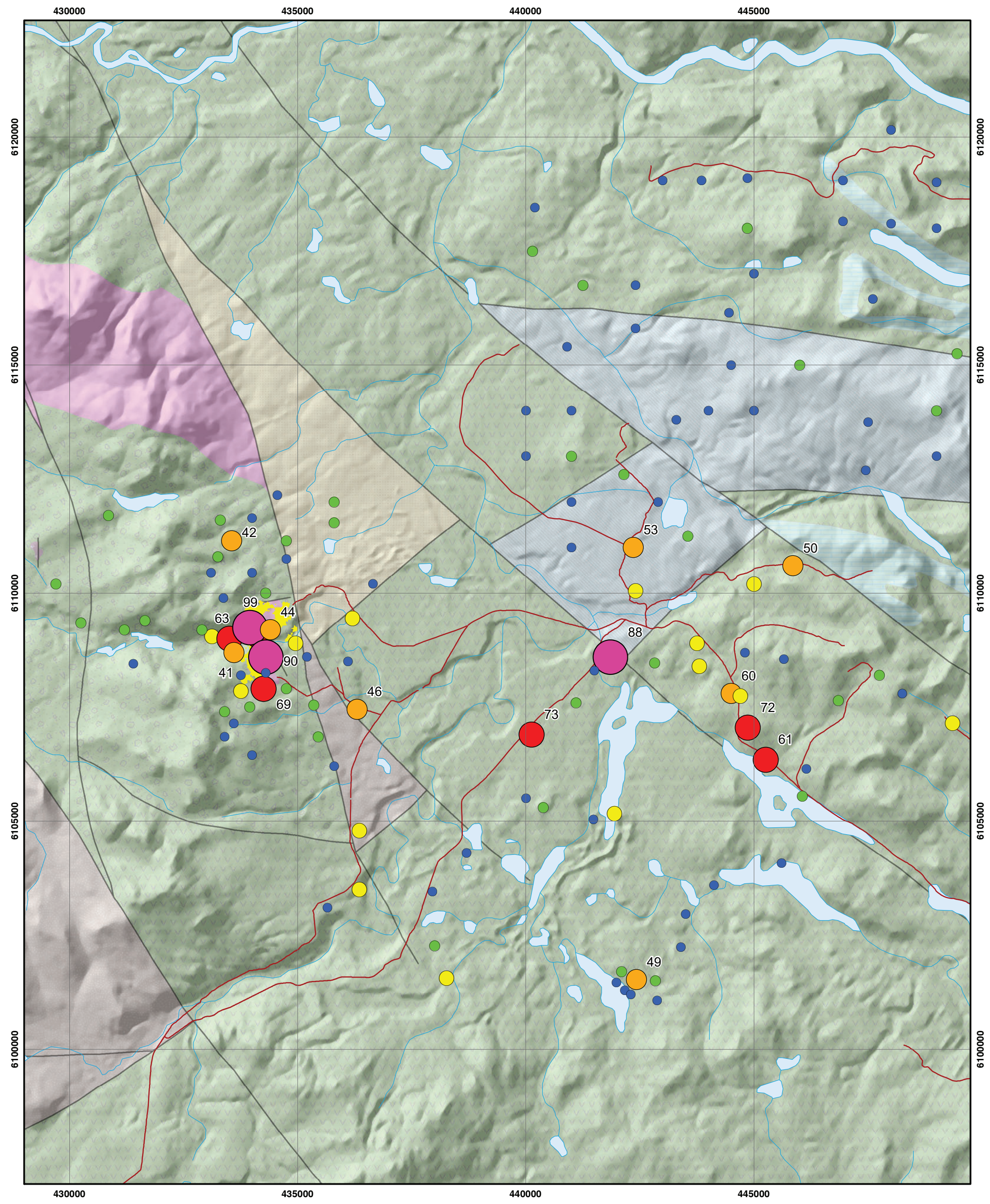
BIOGEOCHEMISTRY
Lodegepole pine bark (ashed)
1 : 150,000



Co

ppm

- 2 - 6
- 7 - 8
- 9 - 11
- 12 - 15
- 16 - 21
- 22 - 28



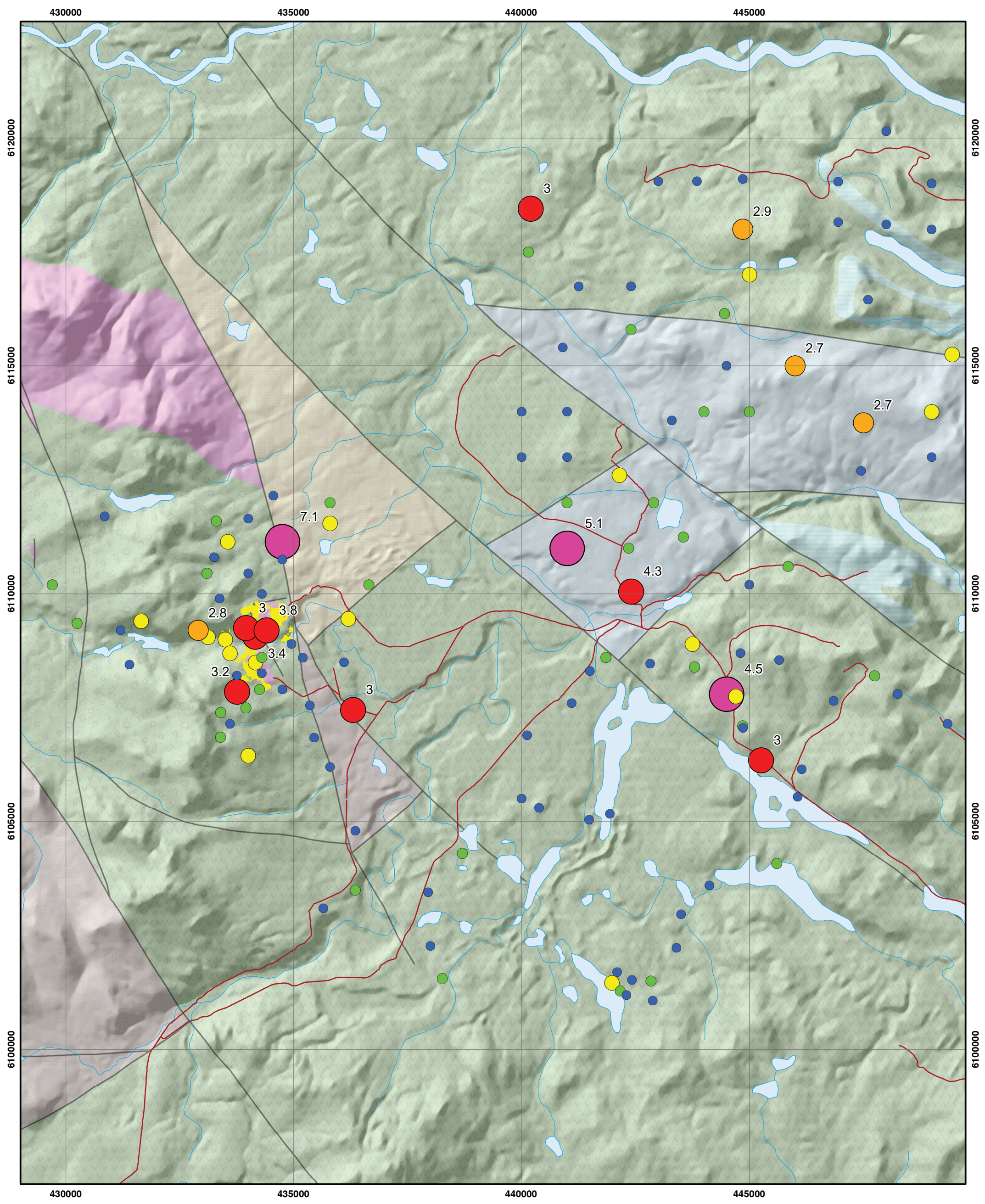
Cr

ppm

- 3 - 11
- 12 - 21
- 22 - 40
- 41 - 60
- 61 - 73
- 74 - 99

Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)

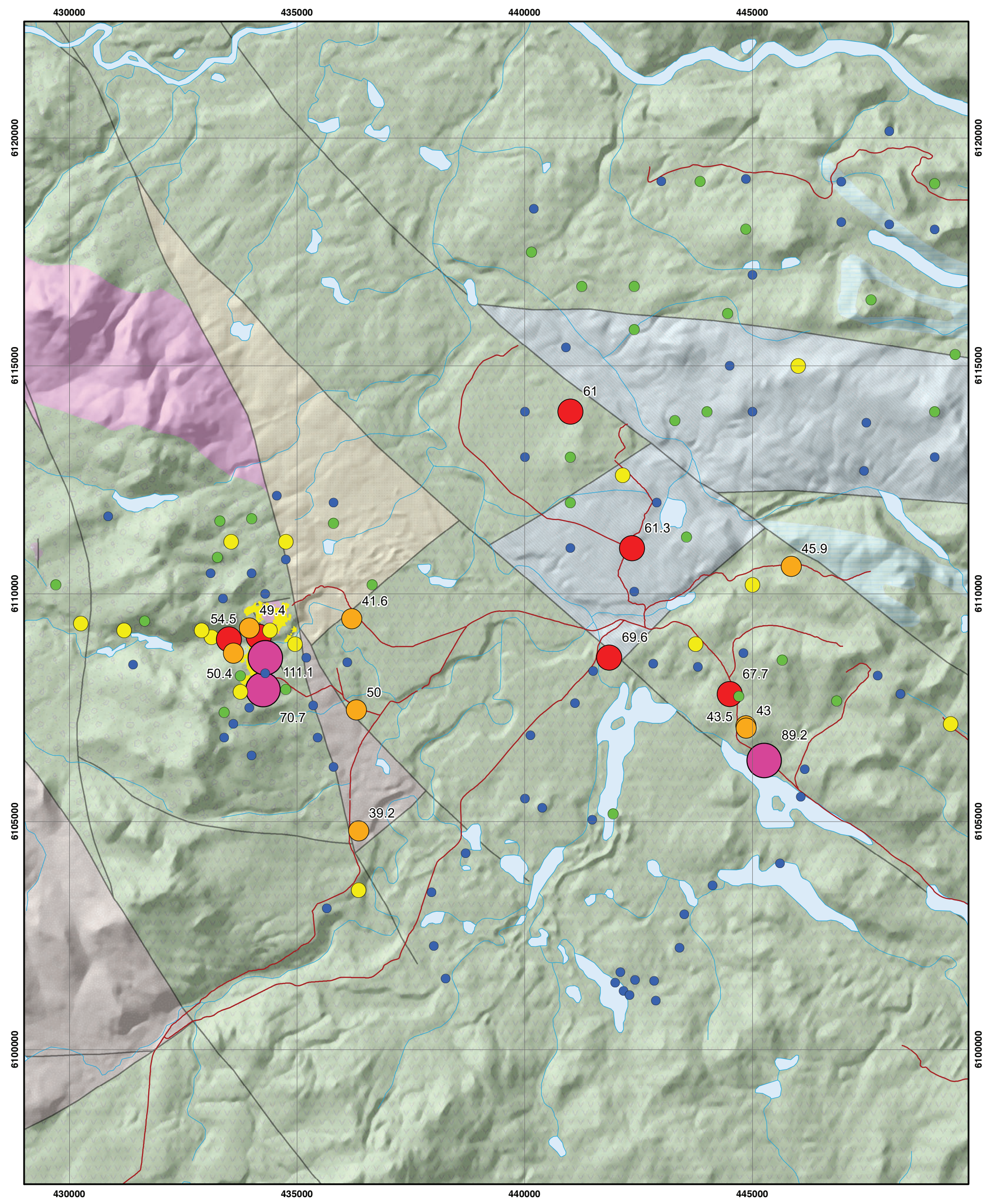
limit of
> 0.15 % Cu grade
1010 bench (metres a.s.l.)
(projected to surface)



Cs

ppm

- 0.3 - 1.3
- 1.4 - 1.9
- 2.0 - 2.6
- 2.7 - 2.9
- 3.0 - 4.3
- 4.4 - 7.1



V

ppm

- 0.0 - 16.0
- 16.1 - 22.4
- 22.5 - 36.4
- 36.5 - 50.4
- 50.5 - 69.6
- 69.7 - 111.1

Data Sources:

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SCALE 1 : 150,000

0 5 10
kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

MT. MILLIGAN

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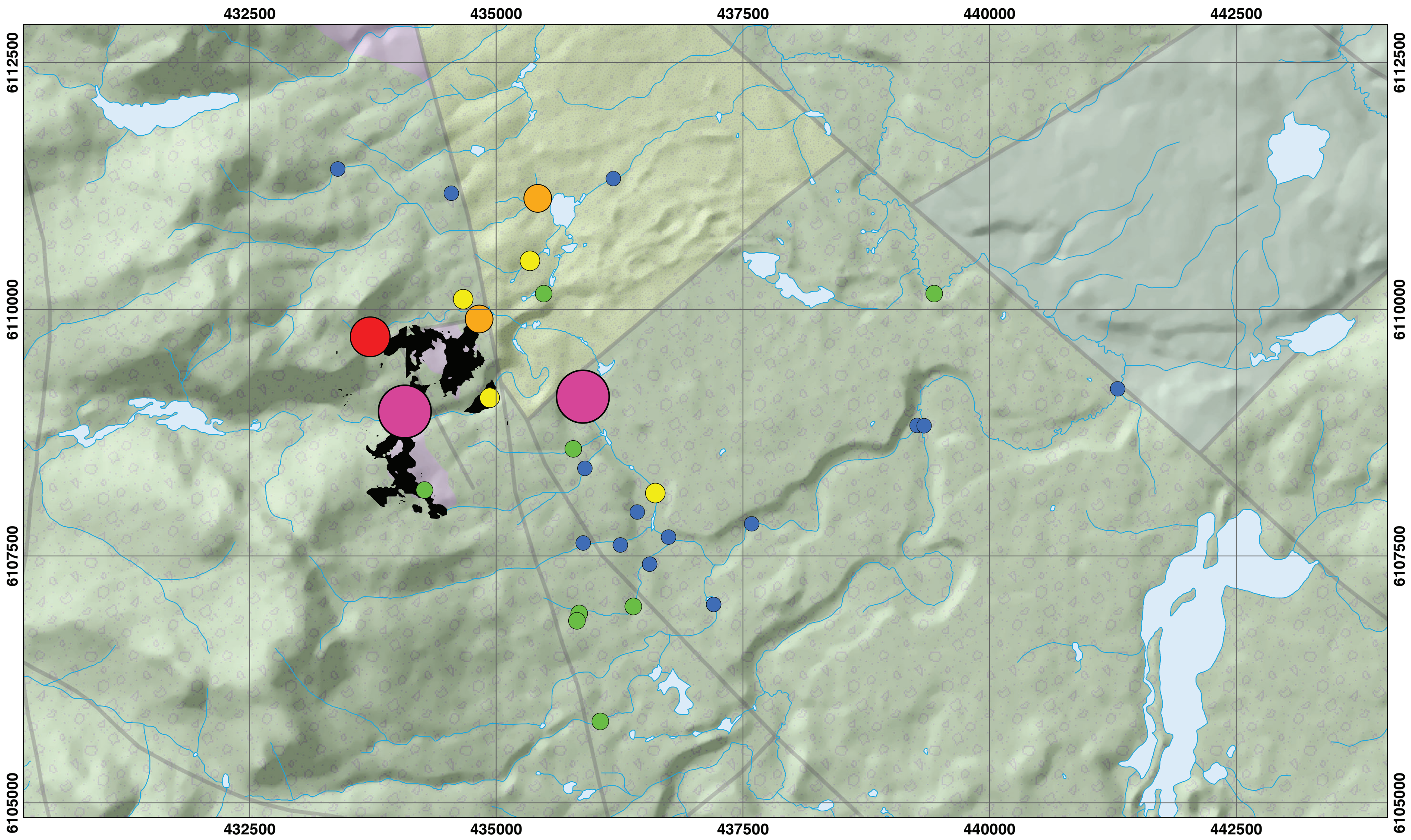
Geoscience BC

STREAM SEDIMENT GEOCHEMISTRY

Bulk leach extractable gold

1 : 50,000



Cu

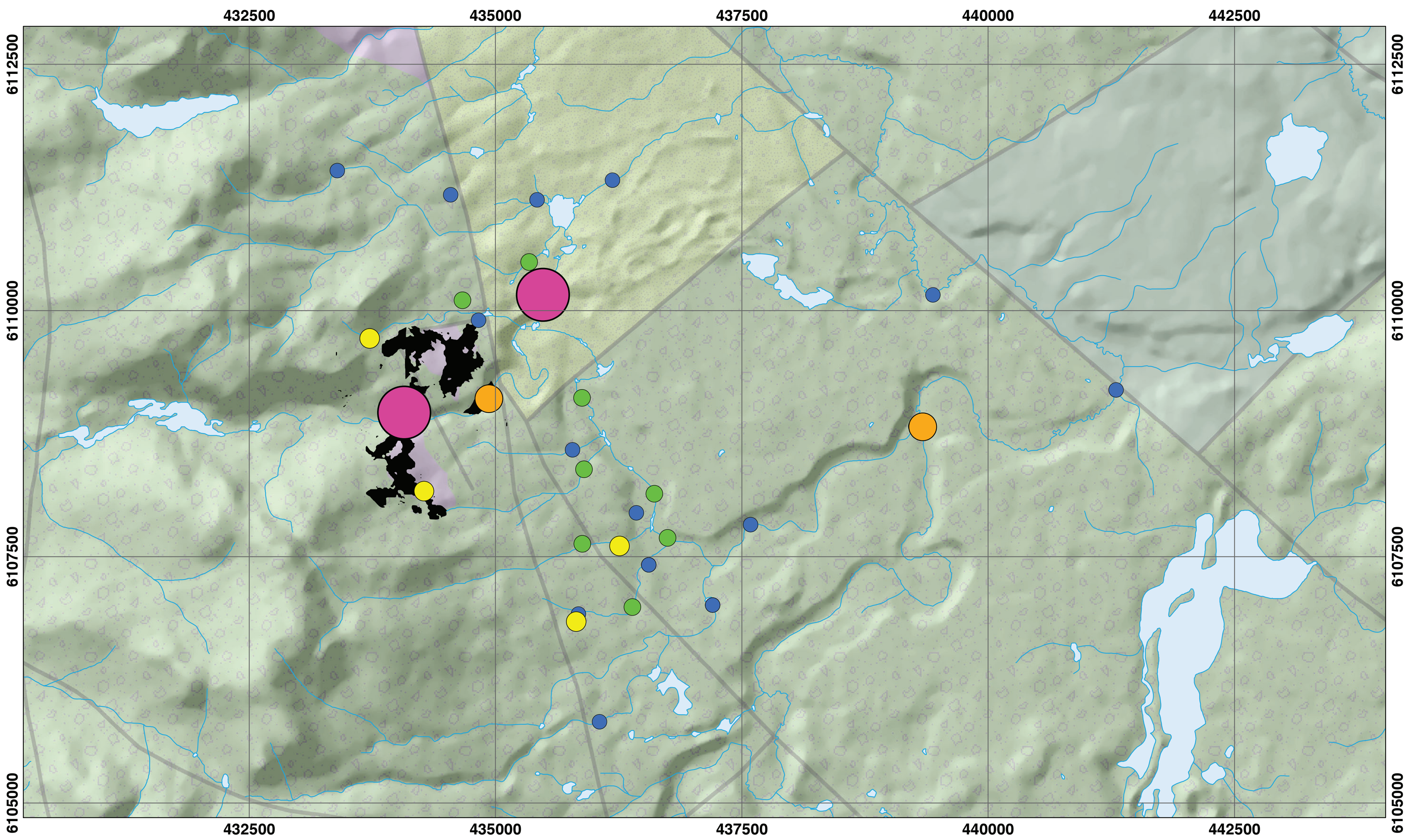
ppm

- 0.01 - 10.49
- 10.50 - 48.51
- 48.52 - 79.82
- 79.83 - 100.60
- 100.61 - 109.42
- 109.43 - 121.10

Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)

limit of
> 0.15 % Cu grade
1010 bench
(projected to surface)

Bedrock geology background
Legend as on page 6.1



Au

ppm

- 0.000 - 0.014
- 0.015 - 0.021
- 0.022 - 0.039
- 0.040 - 0.049
- 0.050 - 0.193
- 0.194 - 0.210

SCALE 1 : 50,000

0 2.5 5
kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

Data Sources:

Lustig, G. and Fonseca, A. (2006): Mt. Milligan Project, Stream Sediment Geochemistry Survey; BC Geological Survey Assessment Report 28210, 148 pages.

In 2005, Placer Dome geologists and consultants delivered the Mt. Milligan Geochemical Footprint Project, using bulk leach extracatable gold (BLEG), silt and water geochemistry to characterize the fluvial geochemical signature of the Mt. Milligan deposit.

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MT. MILLIGAN

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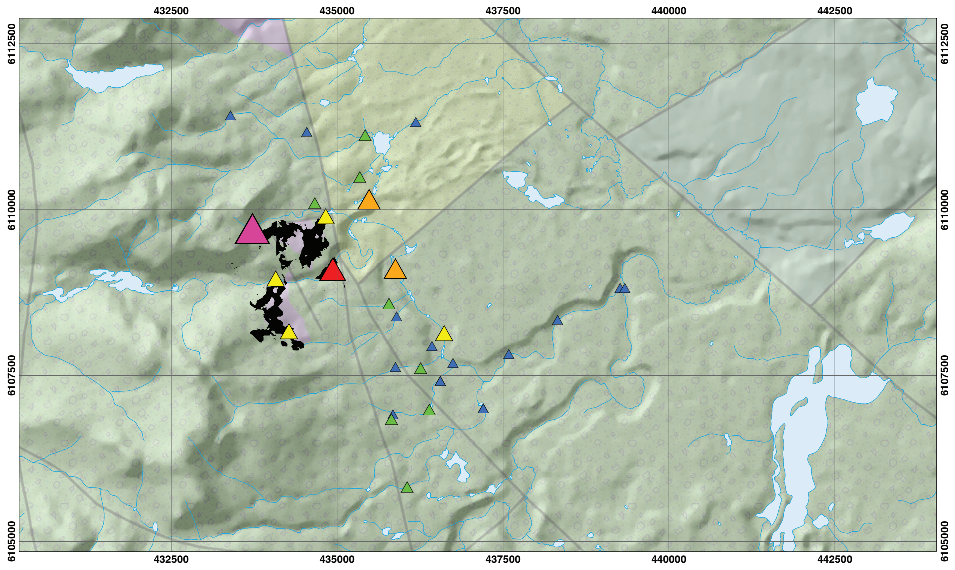
Geoscience BC

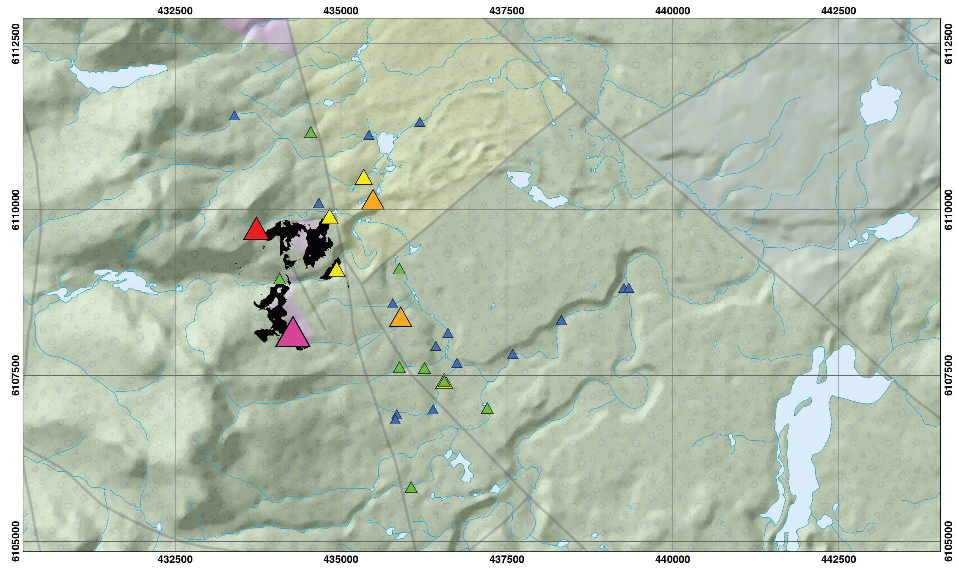
GEOCHEMISTRY
Silt orientation survey
1 : 100,000



Cu

ppm

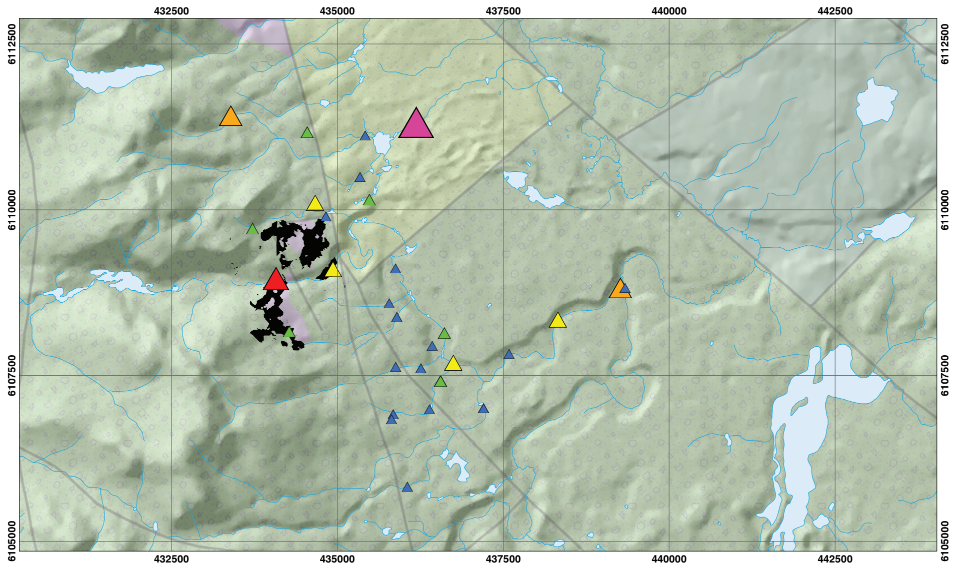
- 25 - 79
- 80 - 120
- 121 - 227
- 228 - 376
- 377 - 532
- 533 - 598



As

ppm

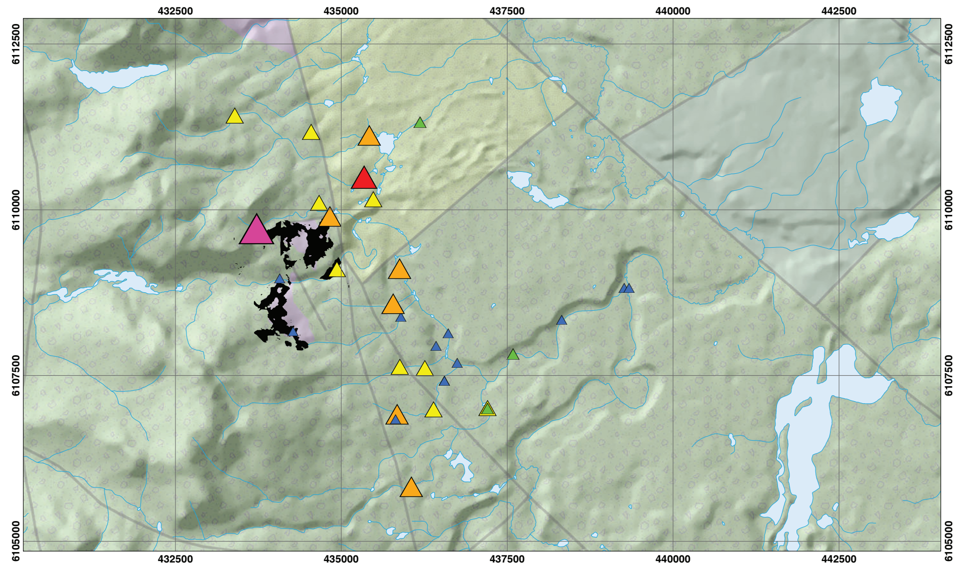
- 3.3 - 10.2
- 10.3 - 13.9
- 14.0 - 19.6
- 19.7 - 31.3
- 31.4 - 33.3
- 33.4 - 35.8



Au

ppm

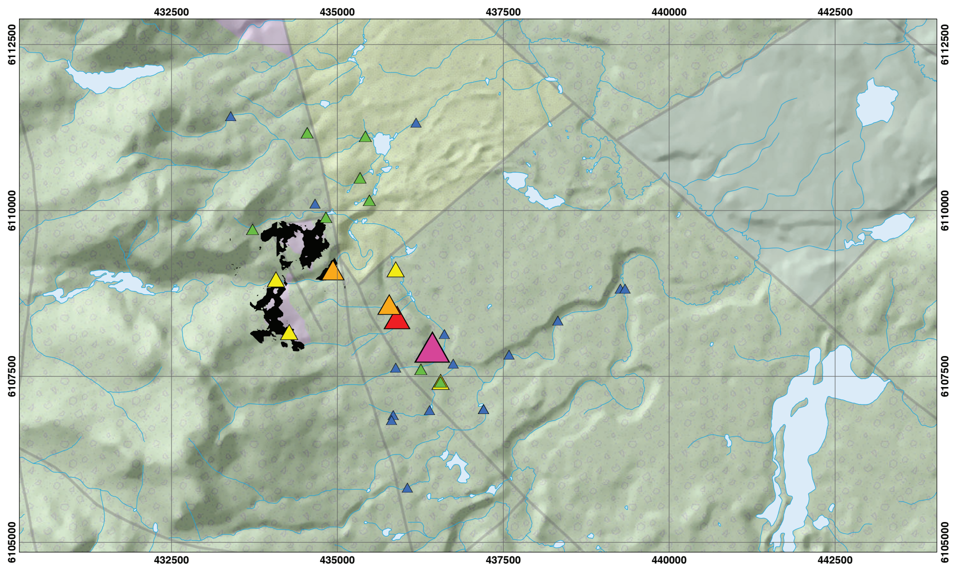
- 0.00 - 0.02
- 0.03 - 0.07
- 0.08 - 0.12
- 0.13 - 0.15
- 0.16 - 0.36
- 0.37 - 0.42



Ca

percent

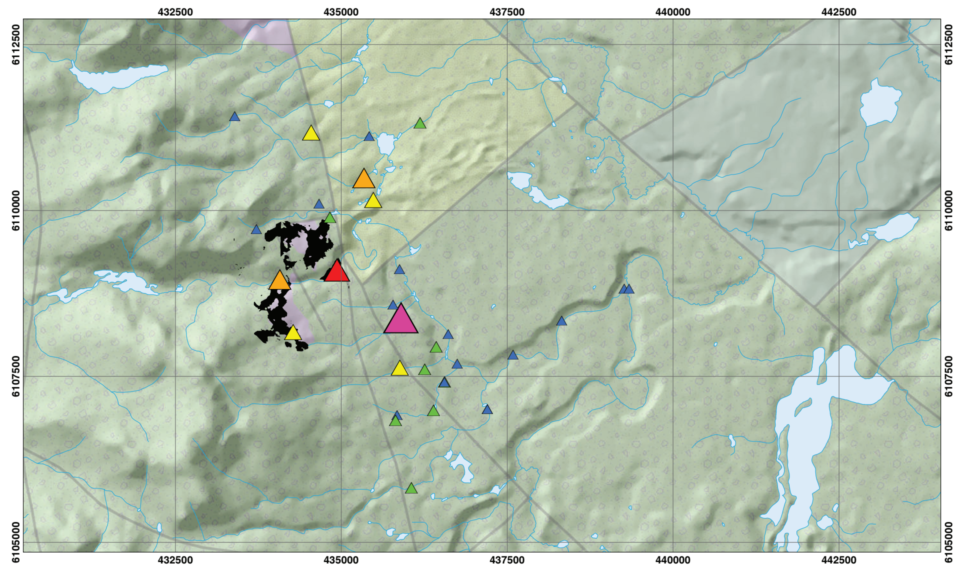
- 0.70 - 0.90
- 0.91 - 0.97
- 0.98 - 1.10
- 1.11 - 1.96
- 1.97 - 2.03
- 2.04 - 2.79



Mo

ppm

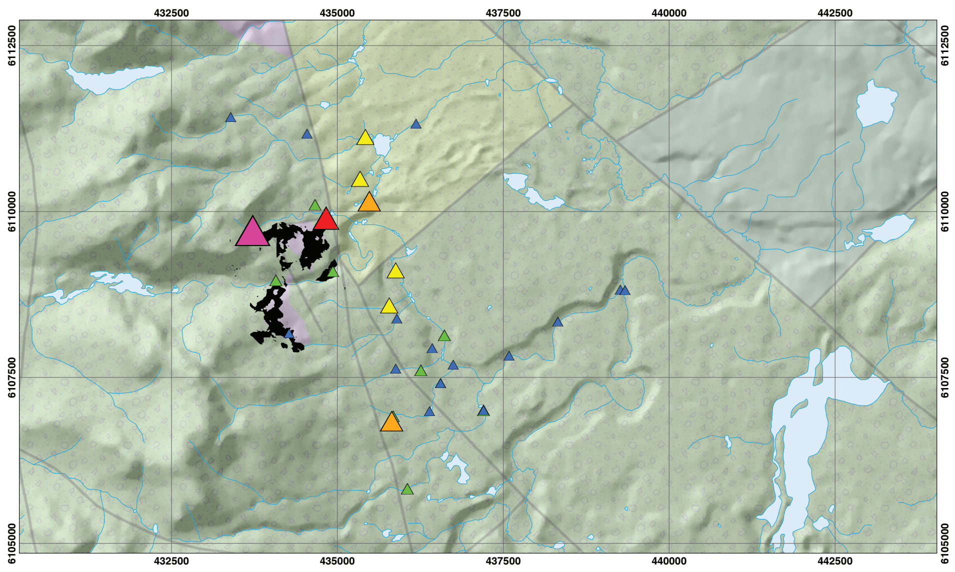
- 0.31 - 1.83
- 1.84 - 3.72
- 3.73 - 7.90
- 7.91 - 9.29
- 9.30 - 50.10
- 50.11 - 148.00



Fe

percent

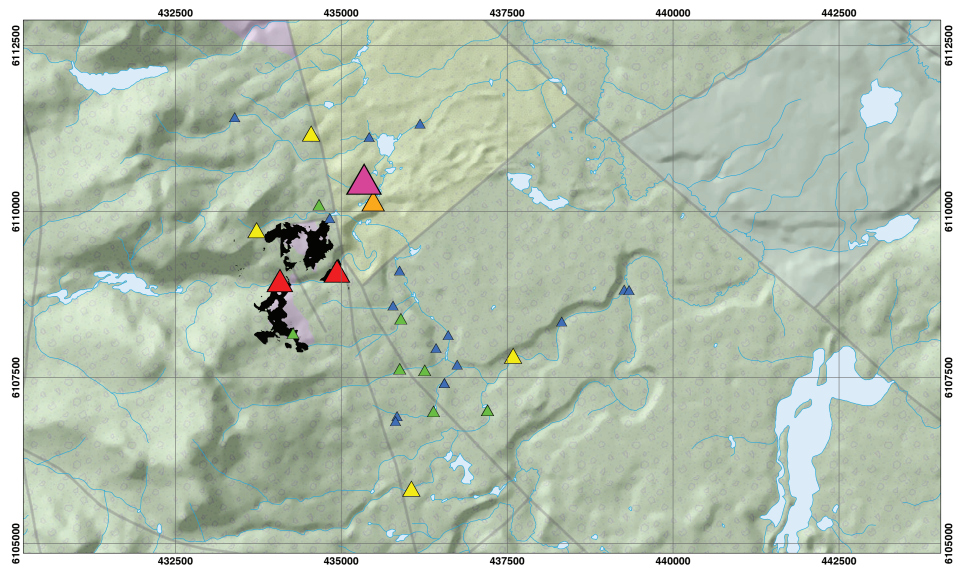
- 1.01 - 3.09
- 3.10 - 4.07
- 4.08 - 5.17
- 5.18 - 6.17
- 6.18 - 6.78
- 6.79 - 8.07



Ag

ppm

- 0.07 - 0.22
- 0.23 - 0.44
- 0.45 - 1.07
- 1.08 - 1.19
- 1.20 - 1.21
- 1.22 - 1.69



Zn

ppm

- 17 - 52
- 53 - 74
- 75 - 87
- 88 - 98
- 99 - 100
- 101 - 104

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Mt. Milligan orebodies

(Centerra 2017, *in* Andrews et al., 2017)

limit of
> 0.15 % Cu grade
1010 bench
(projected to surface)

Bedrock geology background

Legend as on page 6.1

SCALE 1 : 100,000

0 5 10

kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

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MT. MILLIGAN

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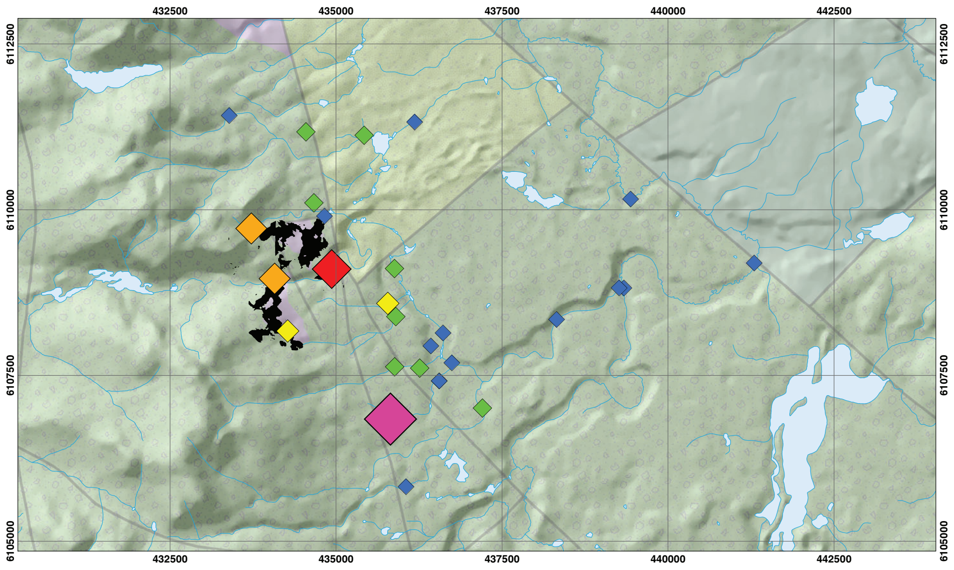
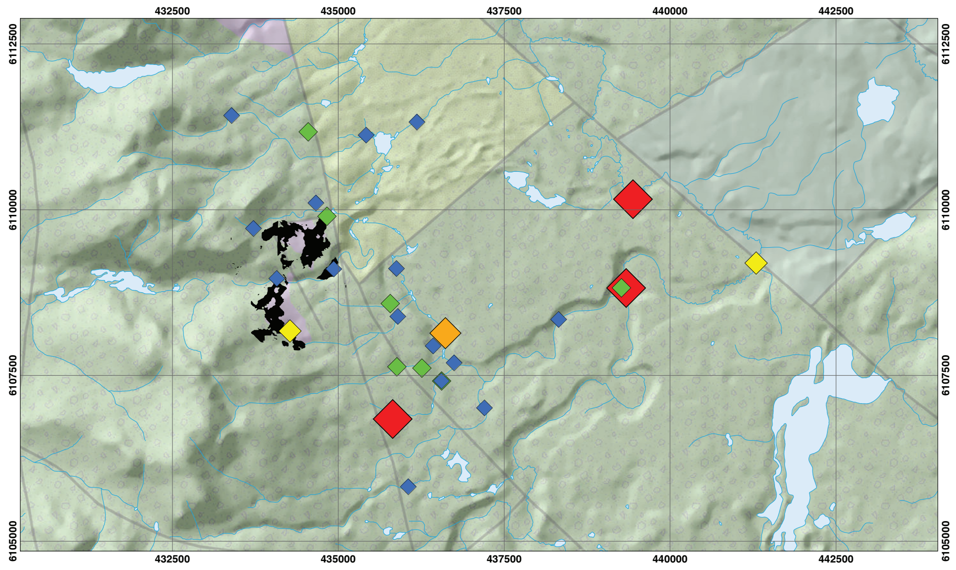
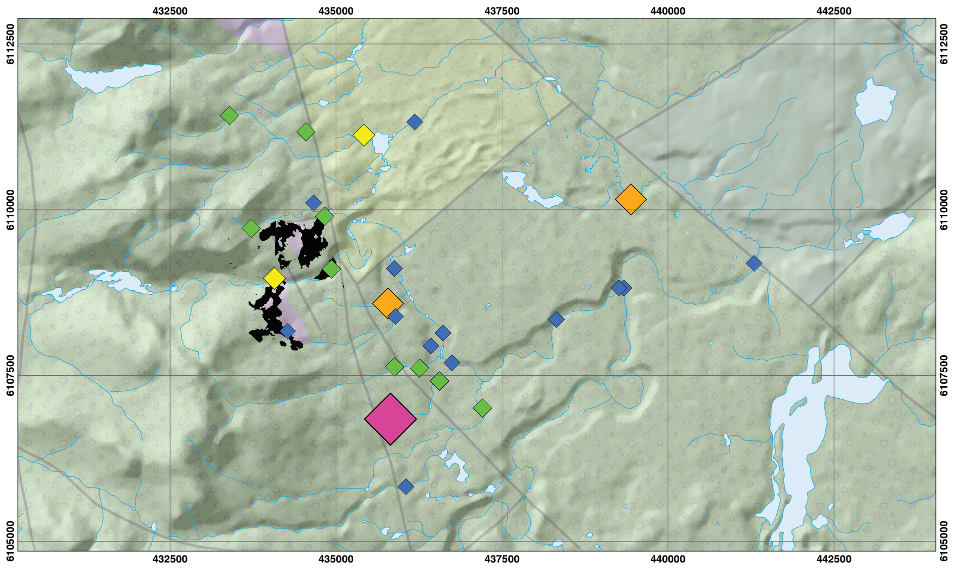
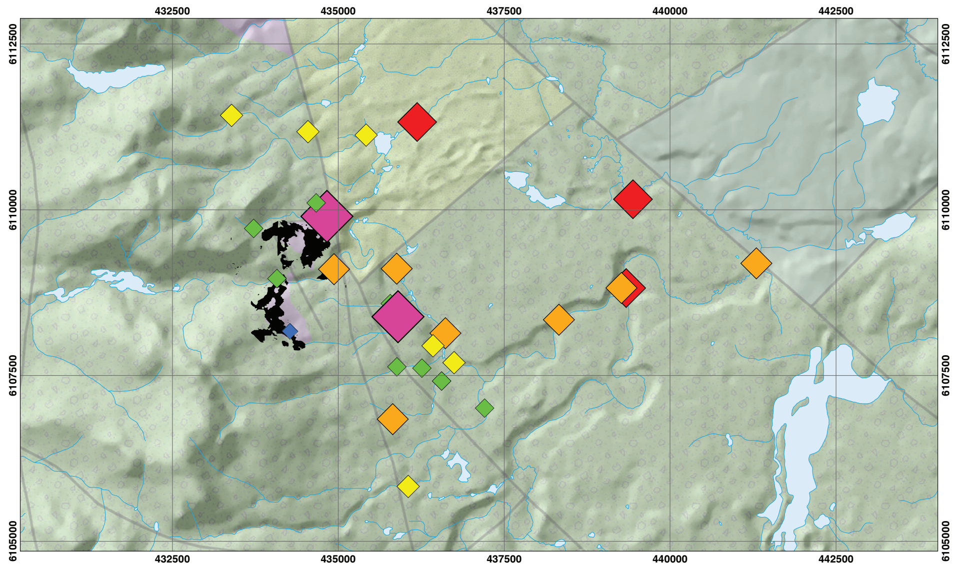
Geoscience BC

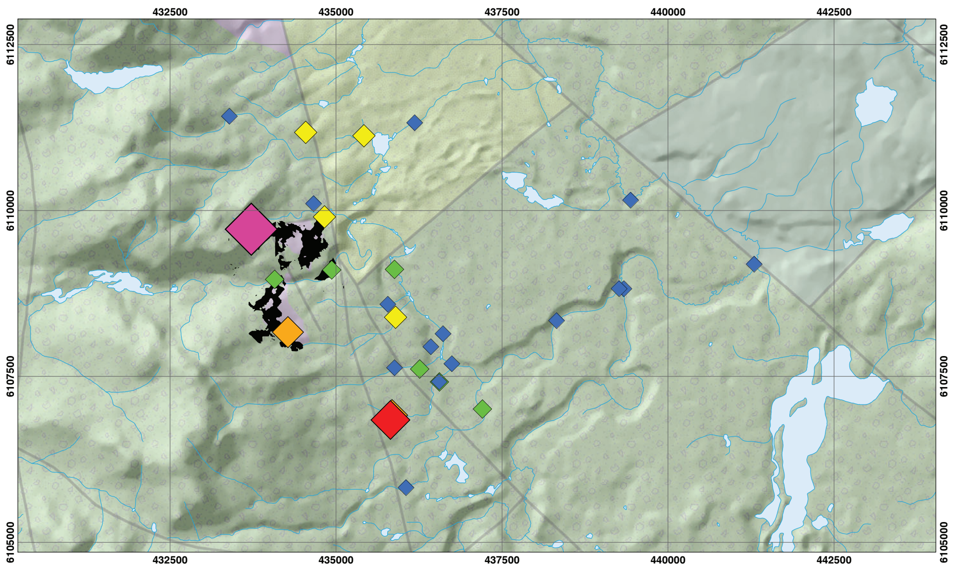
GEOCHEMISTRY
Water orientation survey
1 : 100,000

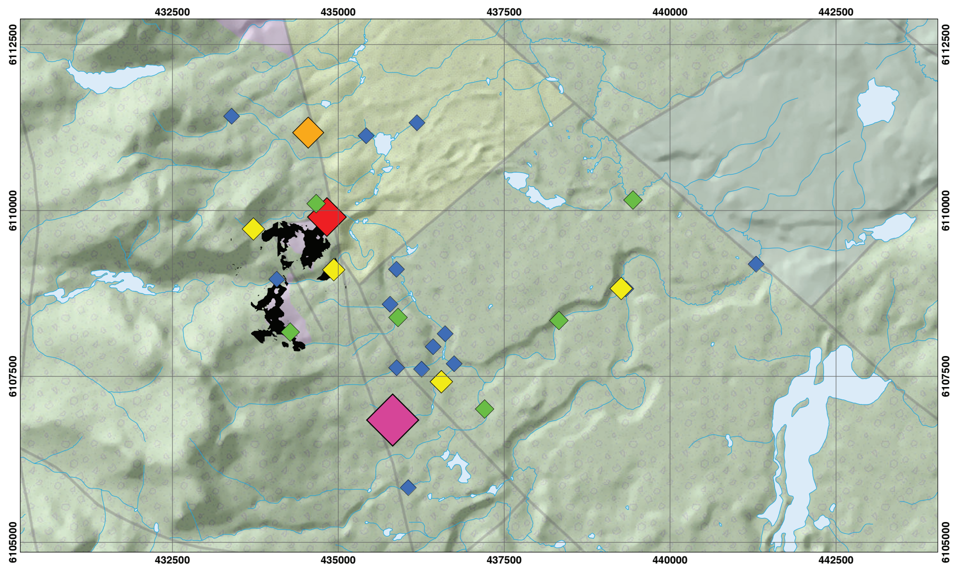


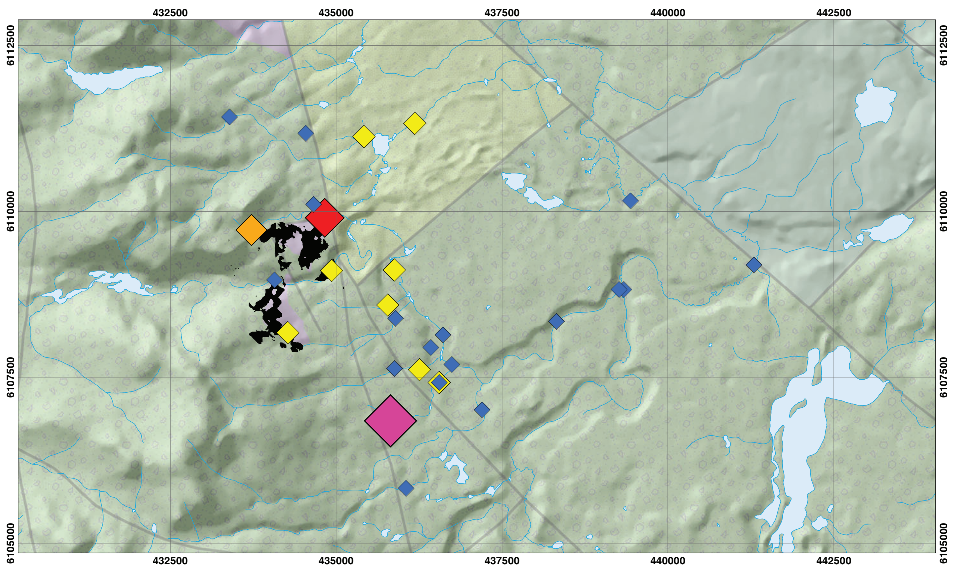


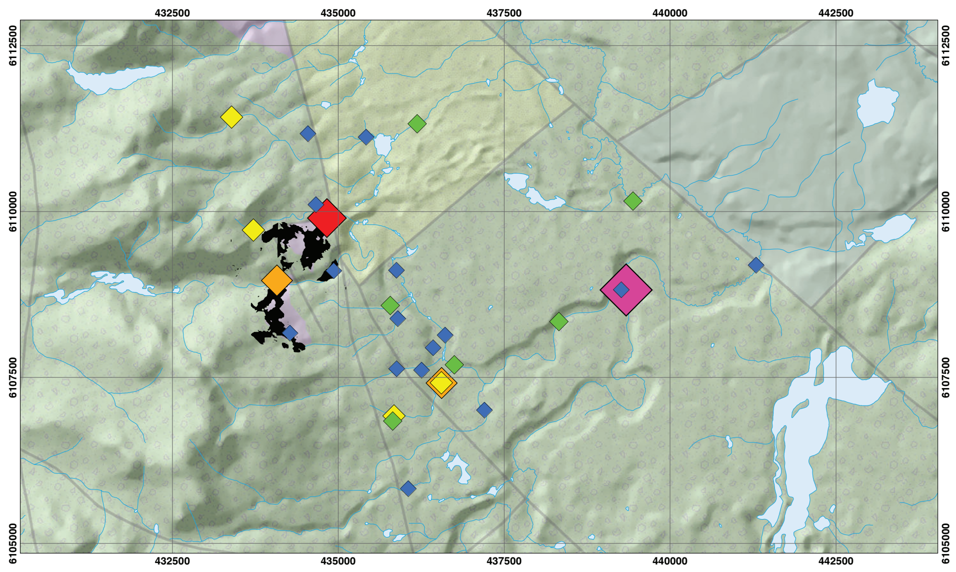












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Mt. Milligan orebodies
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limit of
> 0.15 % Cu grade
1010 bench
(projected to surface)

Bedrock geology background

Legend as on page 6.1

SCALE 1 : 100,000

0 5 10

kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

Porphyry Districts of British Columbia Atlas Series

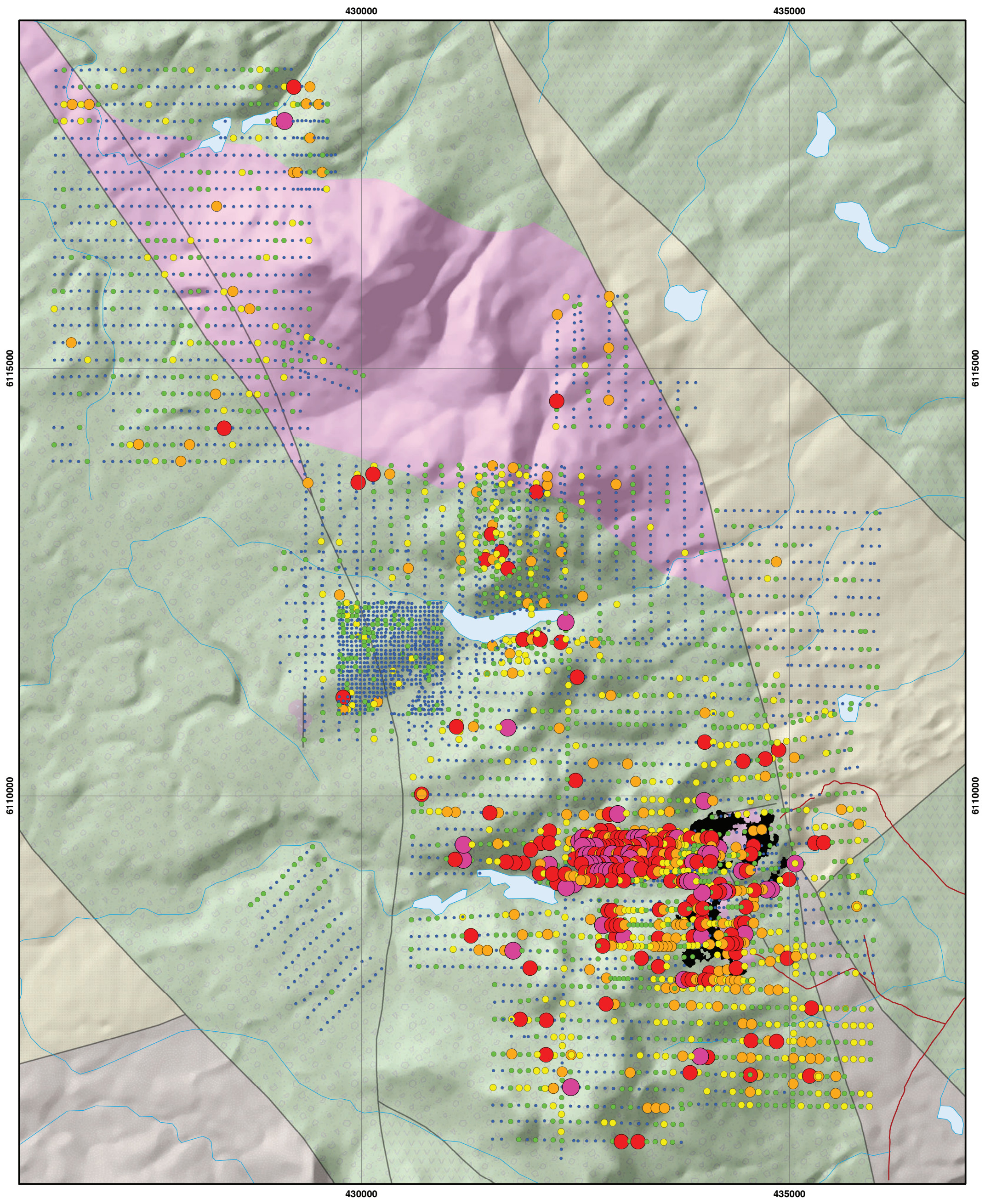
MT. MILLIGAN

A geo-exploration atlas of the Mt. Milligan porphyry copper-gold district

Geoscience BC

GEOCHEMISTRY - Soils

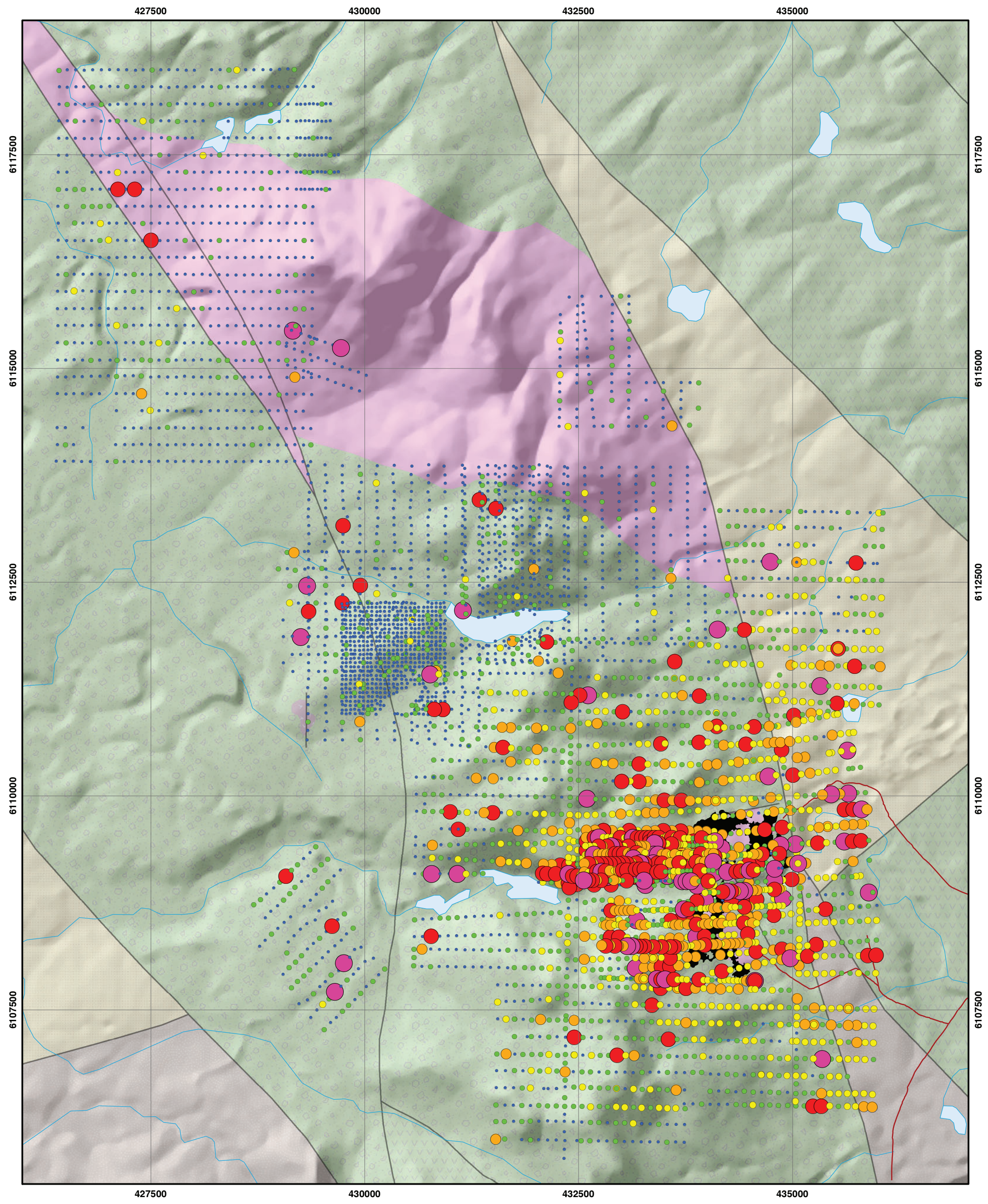
1 : 80,000



Cu

ppm

- 0.0 - 36.0
- 36.1 - 68.7
- 68.8 - 116.0
- 116.1 - 193.0
- 193.1 - 394.0
- 394.1 - 5463.0



Au

ppb

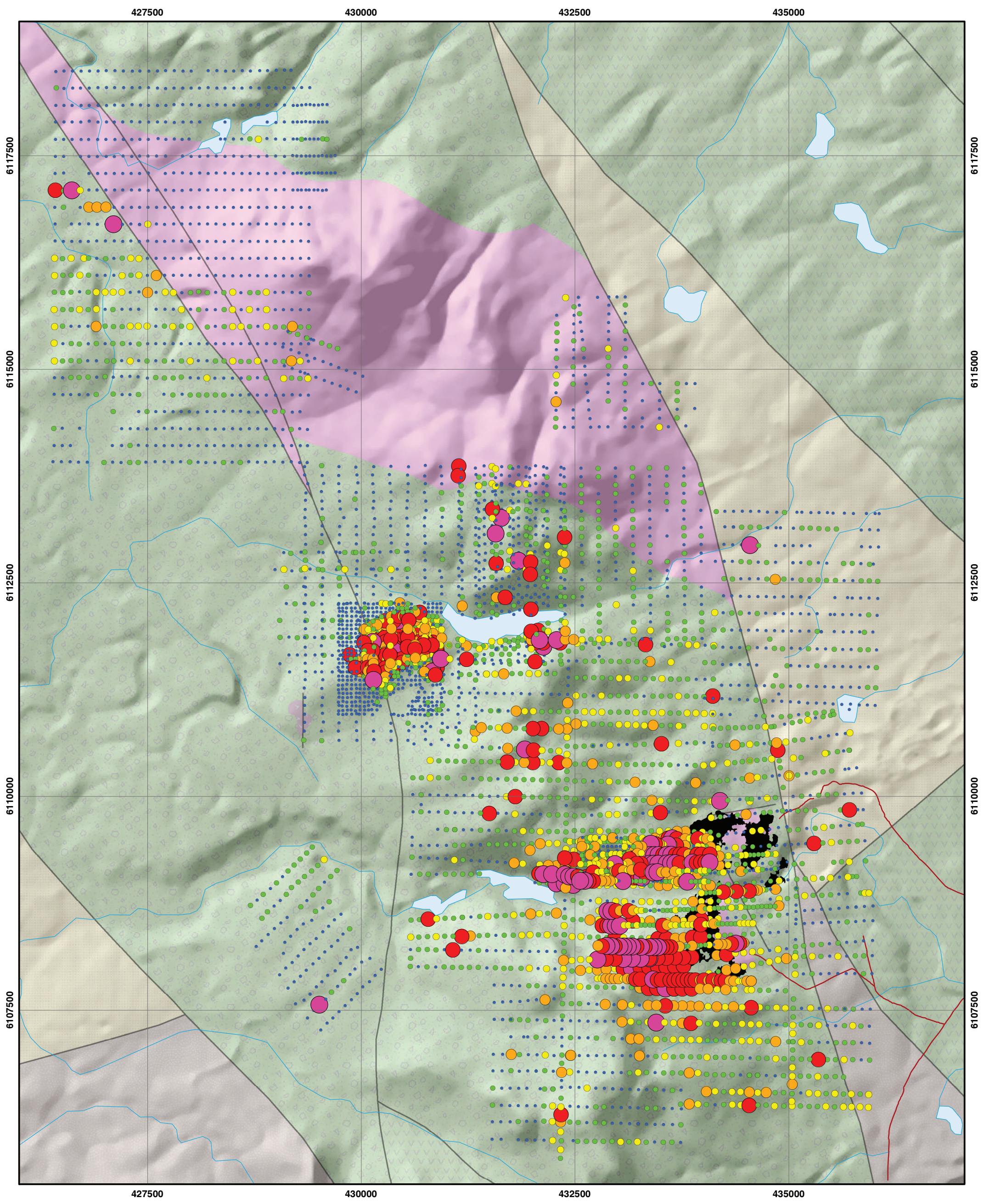
- 0 - 5
- 6 - 21
- 22 - 45
- 46 - 75
- 76 - 235
- 236 - 19100

Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)

limit of
> 0.15 % Cu grade
1010 bench
(projected to surface)

Bedrock geology background

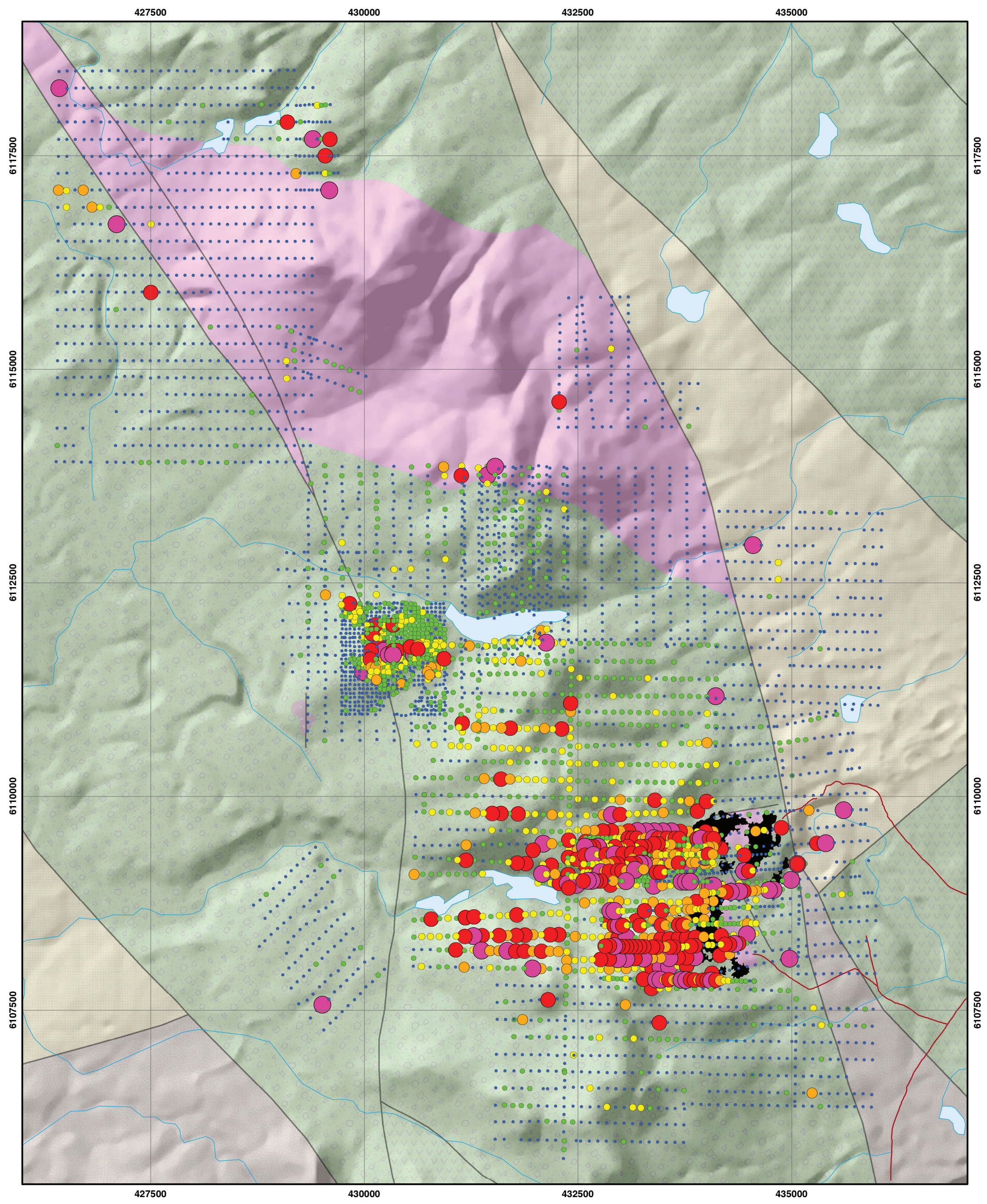
Legend as on page 6.1



As

ppm

- 0.0 - 5.9
- 6.0 - 10.0
- 10.1 - 15.0
- 15.1 - 23.0
- 23.1 - 54.0
- 54.1 - 8654.0



Mo

ppm

- 0.0 - 1.0
- 1.1 - 2.0
- 2.1 - 3.0
- 3.1 - 4.0
- 4.1 - 7.0
- 7.1 - 108.0

Data Sources:

See full references in reference list at end of atlas.

Farmer and Rebagliati (1984): BC Geological Survey Assessment Report 11951.
Heberlein et al. (1984): BC Geological Survey Assessment Report 12912.
Heberlein (2010): BC Geological Survey Assessment Report 31930.
Leriche and Bower (1990): BC Geological Survey Assessment Report 20227.
Myers et al. (1985): BC Geological Survey Assessment Report 13891.
Myers and Rebagliati (1985): BC Geological Survey Assessment Report 14377.
Peters (2011): BC Geological Survey Assessment Report 32703.

This compilation of soil sample surveys includes results from the 1980s, 1990, and 2010-2011. All soil sample preparation reported includes samples being dried and sieved to -80 mesh, with aqua regia digestion. The samples in the earlier surveys were analyzed by ICP-AES with gold by fire assay and AA. The more recent surveys moved to analysis by ICP-MS.

SCALE 1 : 80,000

0 4 8
kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

Porphyry Districts of British Columbia Atlas Series

MT. MILLIGAN

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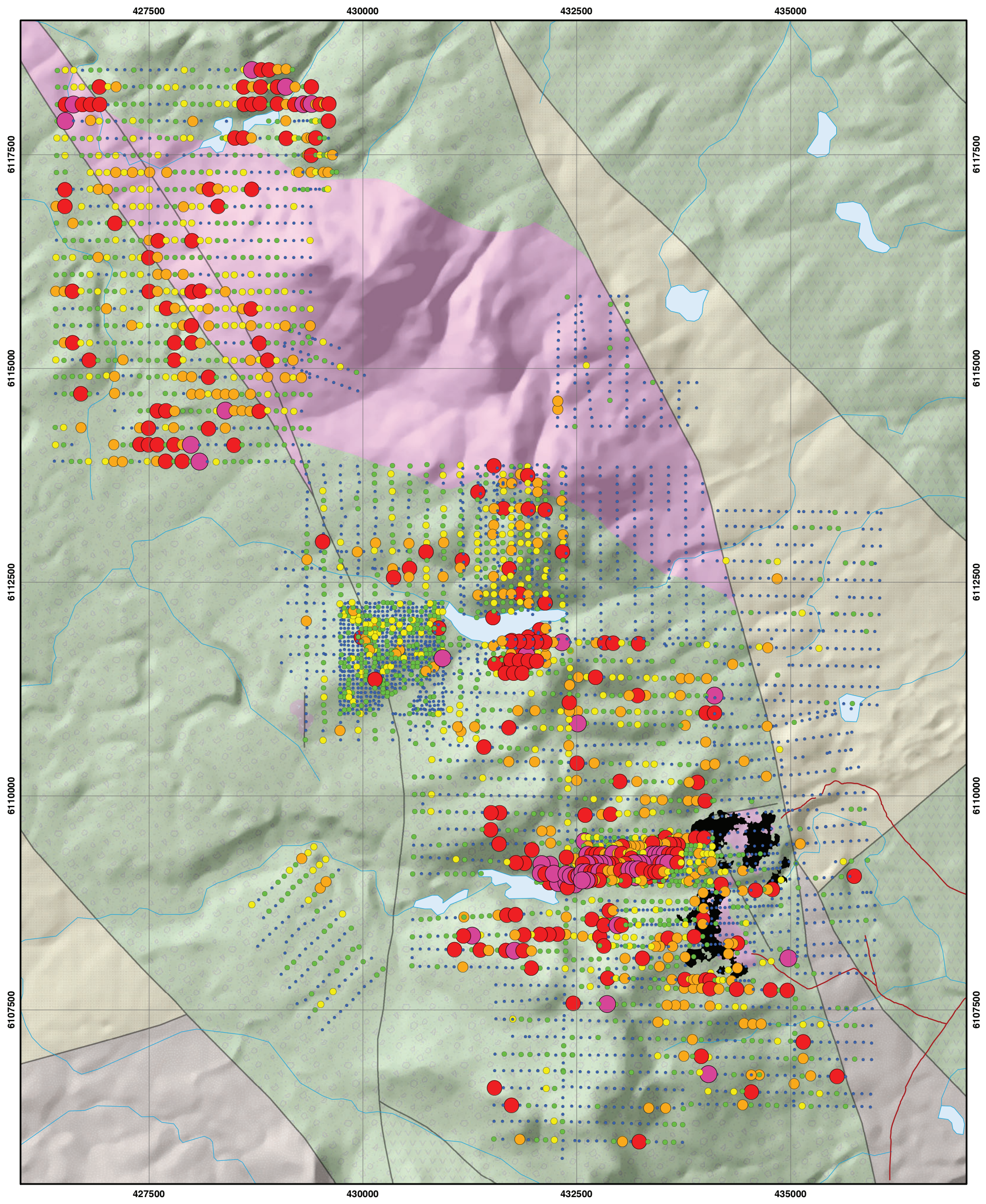
Geoscience BC

GEOCHEMISTRY - Soils

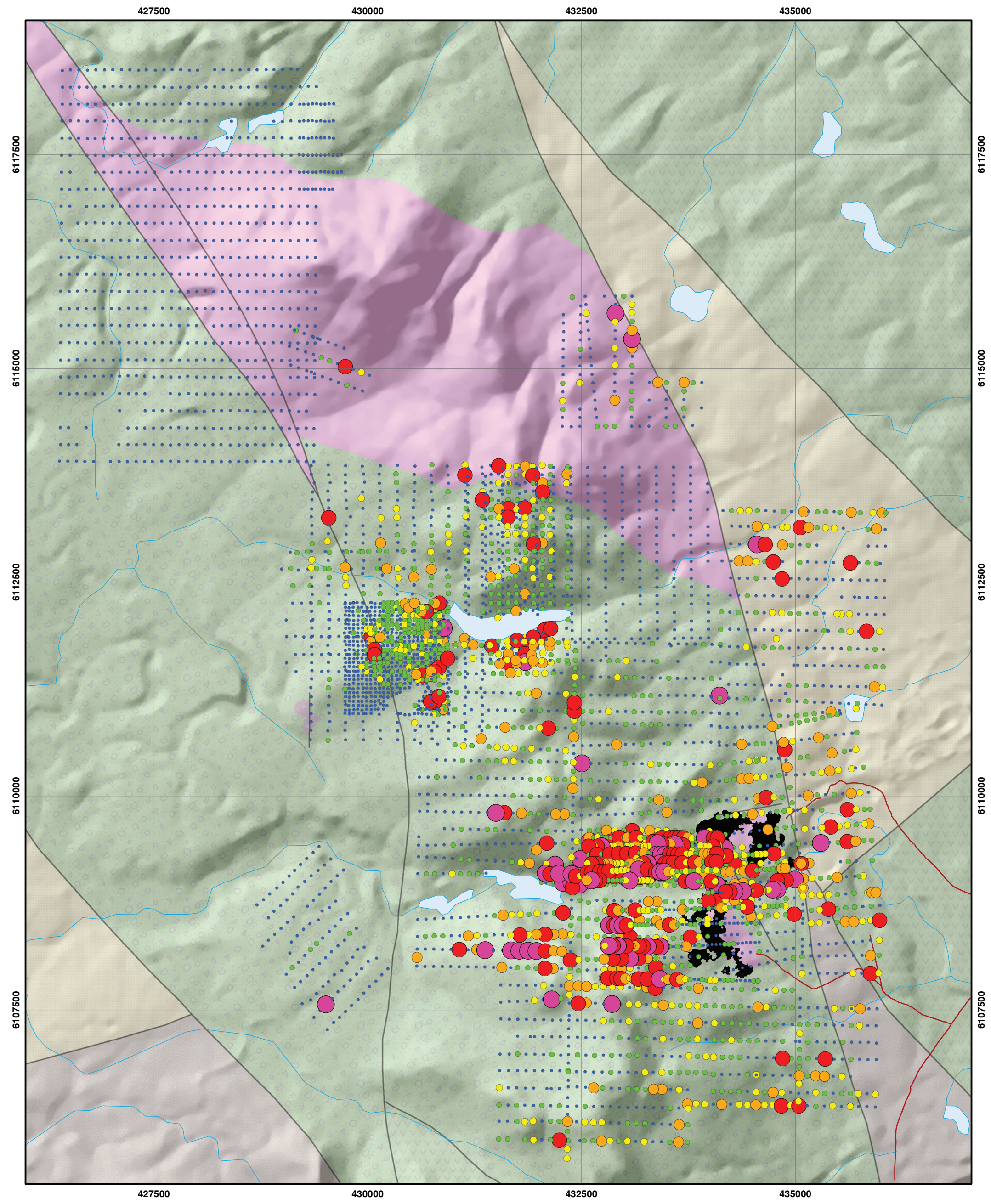
1 : 80,000



Co

ppm

- 0.0 - 8.1
- 8.2 - 11.0
- 11.1 - 13.9
- 14.0 - 16.9
- 17.0 - 27.0
- 27.1 - 127.0



Fe

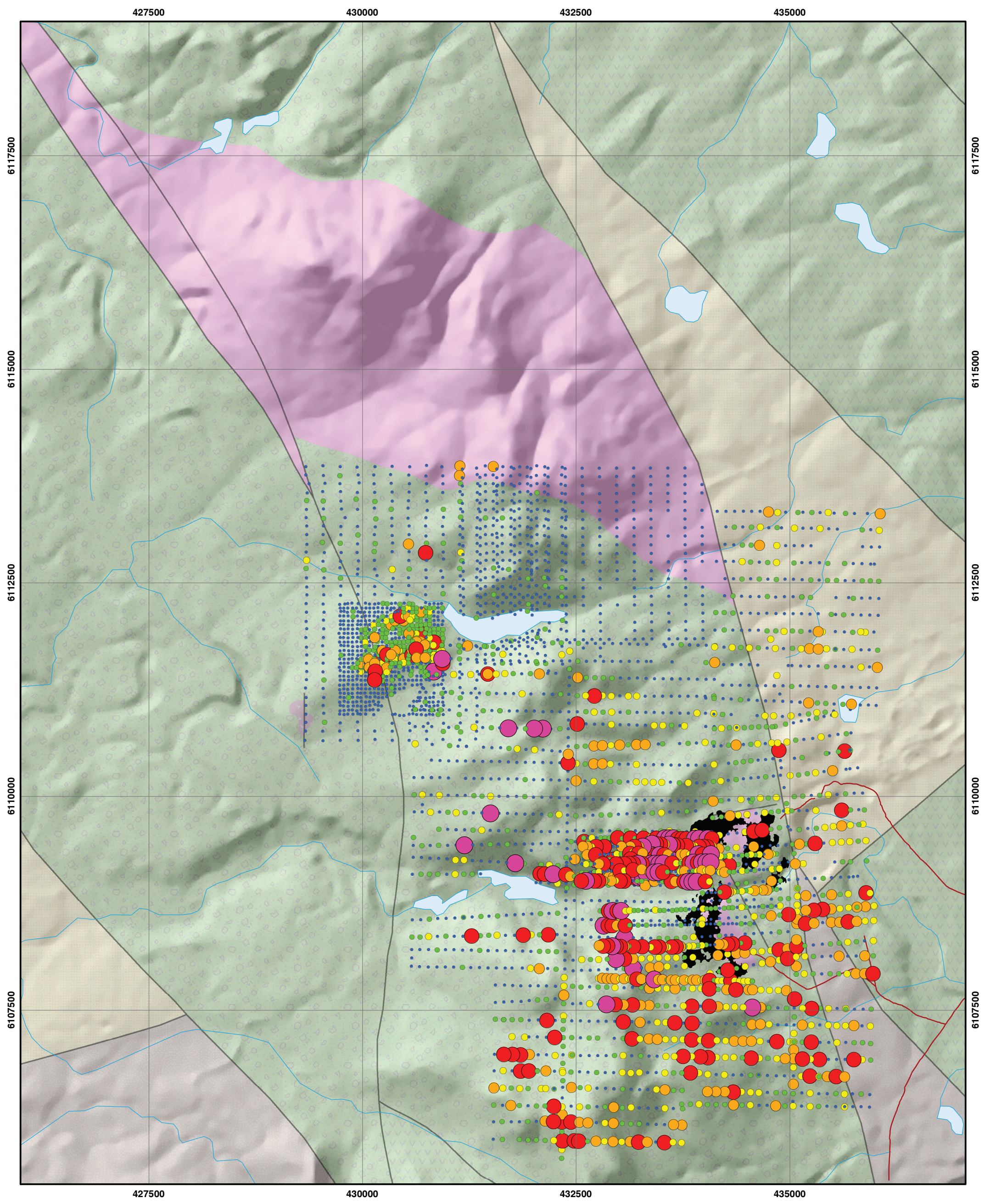
percent

- 0.00 - 3.48
- 3.49 - 4.29
- 4.30 - 4.92
- 4.93 - 5.48
- 5.49 - 6.90
- 6.91 - 16.75

Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)

limit of
> 0.15 % Cu grade
1010 bench
(projected to surface)

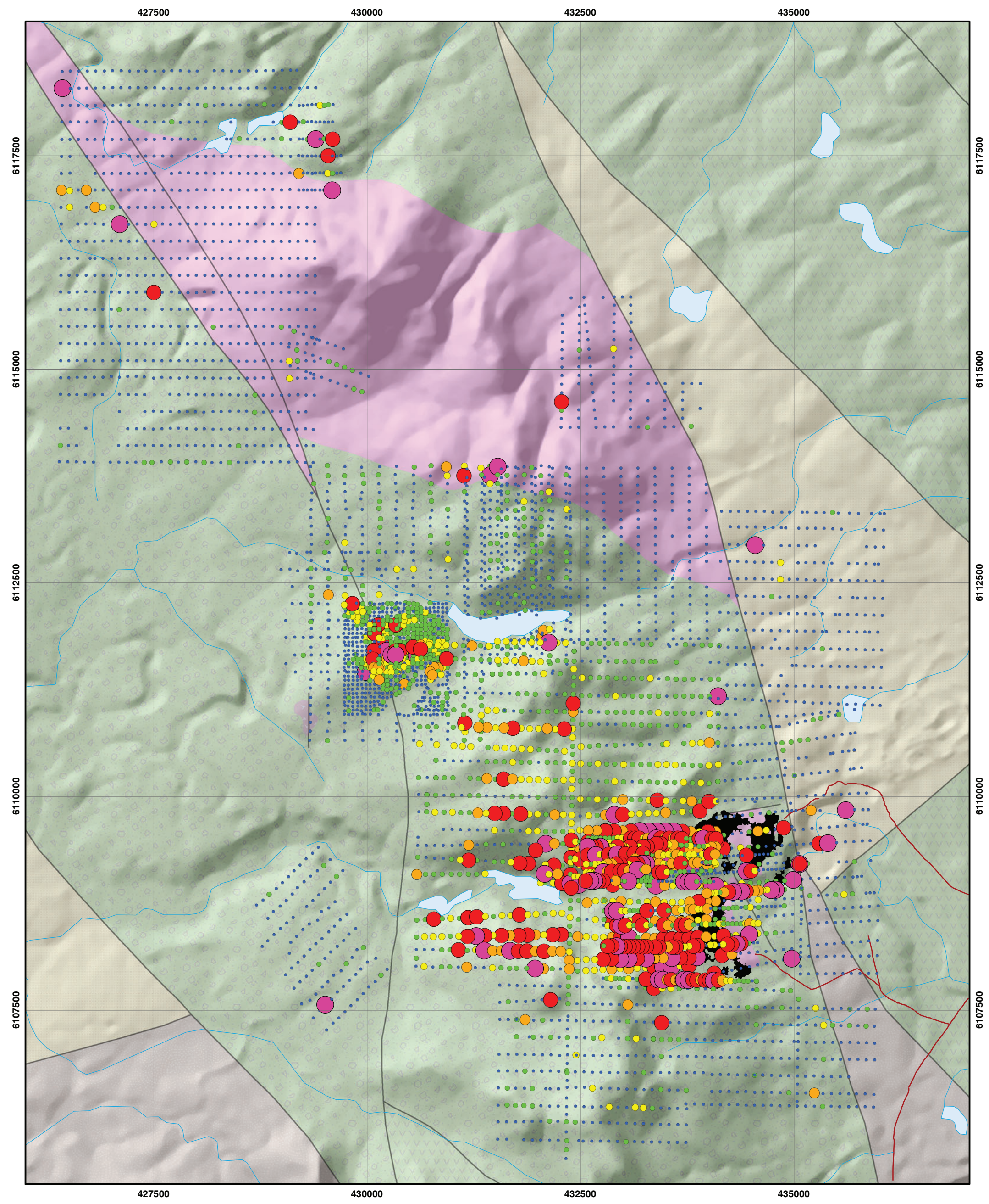
Bedrock geology background
Legend as on page 6.1



Pb

ppm

- 0.0 - 6.0
- 6.1 - 9.0
- 9.1 - 10.9
- 11.0 - 12.8
- 12.9 - 18.0
- 18.1 - 1585.0



Zn

ppm

- 0.0 - 46.9
- 47.0 - 62.0
- 62.1 - 76.0
- 76.1 - 90.0
- 90.1 - 120.0
- 120.1 - 902.0

Data Sources:

See full references in reference list at end of atlas.

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Heberlein et al. (1984): BC Geological Survey Assessment Report 12912.
Heberlein (2010): BC Geological Survey Assessment Report 31930.
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SCALE 1 : 80,000

0 4 8
kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

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MT. MILLIGAN

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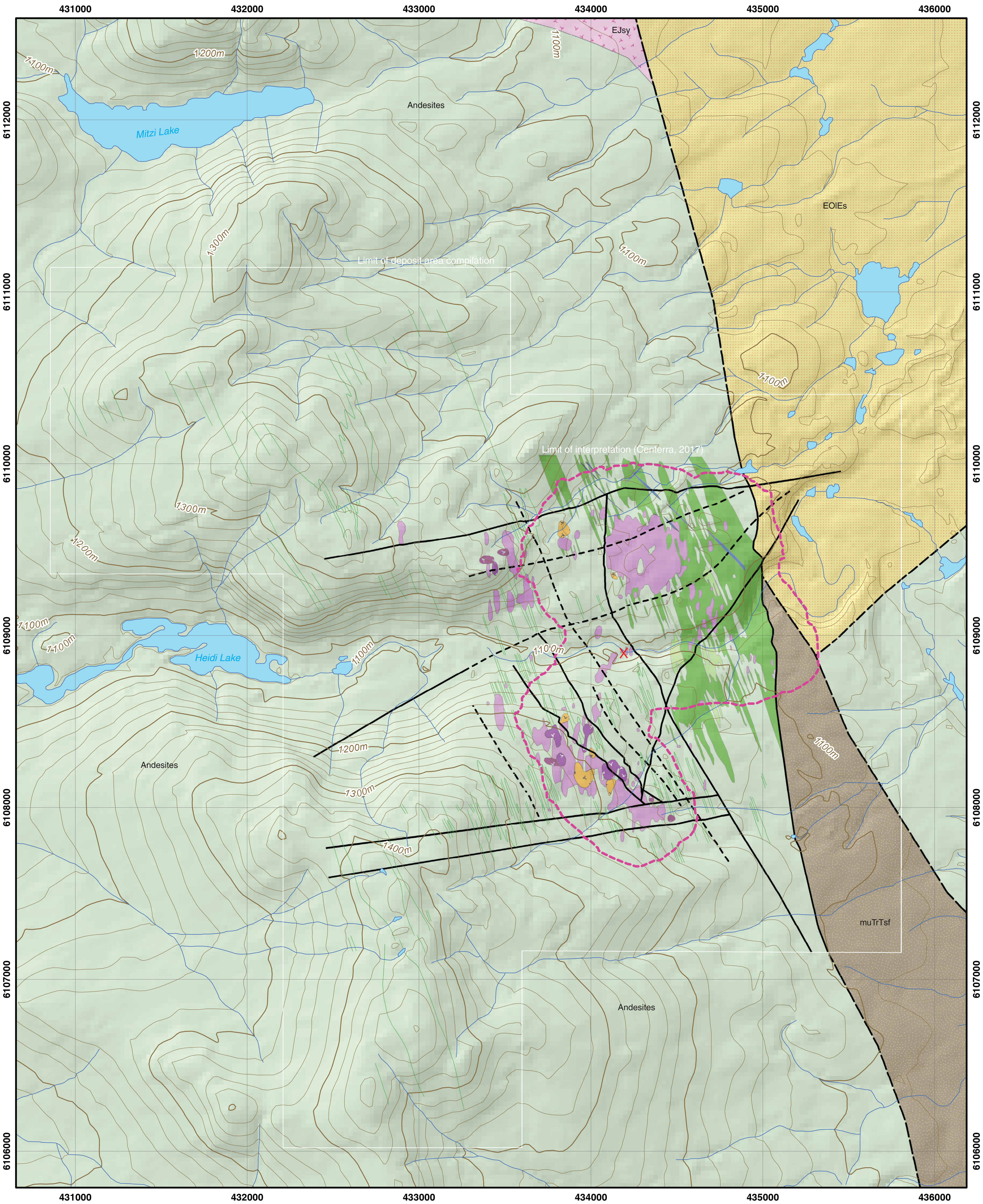
Geoscience BC

BEDROCK GEOLOGY

1 : 20,000



Overlap assemblages and postaccretionary rocks

EOCENE - OLIGOCENE

EOlEs — Nechako Plateau Group sedimentary rocks: Sandstone, mudstone, pebble conglomerate, volcanic wacke, volcanic ash and basalts

Triassic-Jurassic Quesnel terrane

EARLY JURASSIC (intrusive rocks)

EJsy — Syenitic to monzonitic intrusions

Mount Milligan deposit area intrusions

- Post mineral dykes
- Hydrothermal breccia
- Xenolithic monzonite breccia
- Hornblende monzonite porphyry
- Monzonite porphyry

MIDDLE - UPPER TRIASSIC (stratified rocks)

Takla Group

muTrTsf — Sedimentary rocks: Mudstone, siltstone, shale, fine clastic rocks

Mt Milligan deposit area: Latite or K-altered andesite.

Mt Milligan deposit area: Trachyte or bedded epiclastic

Andesites — Calc-alkaline andesitic volcaniclastic rocks, incl. Witch Lake Formation. Dominated by volcanic flows, breccia and agglomerates; augite with lessor plagioclase bearing rocks, augite-phyric and aphyric basalt breccia, agglomerate, tuff and flows.

Linework and symbols

Contacts between discrete units within the andesitic rocks.

X Area of discovery outcrops: R. Haslinger in 1983. Creek zone, now called Saddle zone

Mt. Milligan mine

(Centerra 2020, *in* Fitzgerald et al., 2020)

Ultimate pit outline

SCALE 1 : 20,000

0 1 2

kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

Data Sources:

Mt. Milligan deposit area:

Andrews, P., Berthelsen, D., Lipiec, I. (2017): Technical report on the Mount Milligan Mine north-central British Columbia; NI 43-101 report for Centerra Gold Inc., pp 238.

Fitzgerald, J., Jago, C.P., Jankovic, S., Simoniam, B., Taylor, C.A., Borntraeger, B. (2020): Technical report on the Mount Milligan Mine north-central British Columbia; NI 43-101 report for Centerra Gold Inc., pp268.

Local geology:

Heberlein, D.R., Rebagliati, C.M., Hoffman, S.J. (1984): Assessment report on the 1984 geological and geochemical exploration activities Phil A, B, and 1 claim groups; BC Geological Survey Assessment Report 12912, pp. 271.

Logan, J.M., Schiarizza, P., Struik, L.C., Barnett, C., Nelson, J.L., Kowalczyk, P., Ferri, F., Mihalynuk, M.G., Thomas, M.D., Gammon, P., Lett, R., Jackaman, W. and Ferbey, T., 2010: Bedrock Geology of the QUEST map area, central British Columbia; British Columbia Geological Survey Geoscience Map 2010-1, Geoscience BC Report 2010-5, and Geological Survey of Canada Open File 6476.

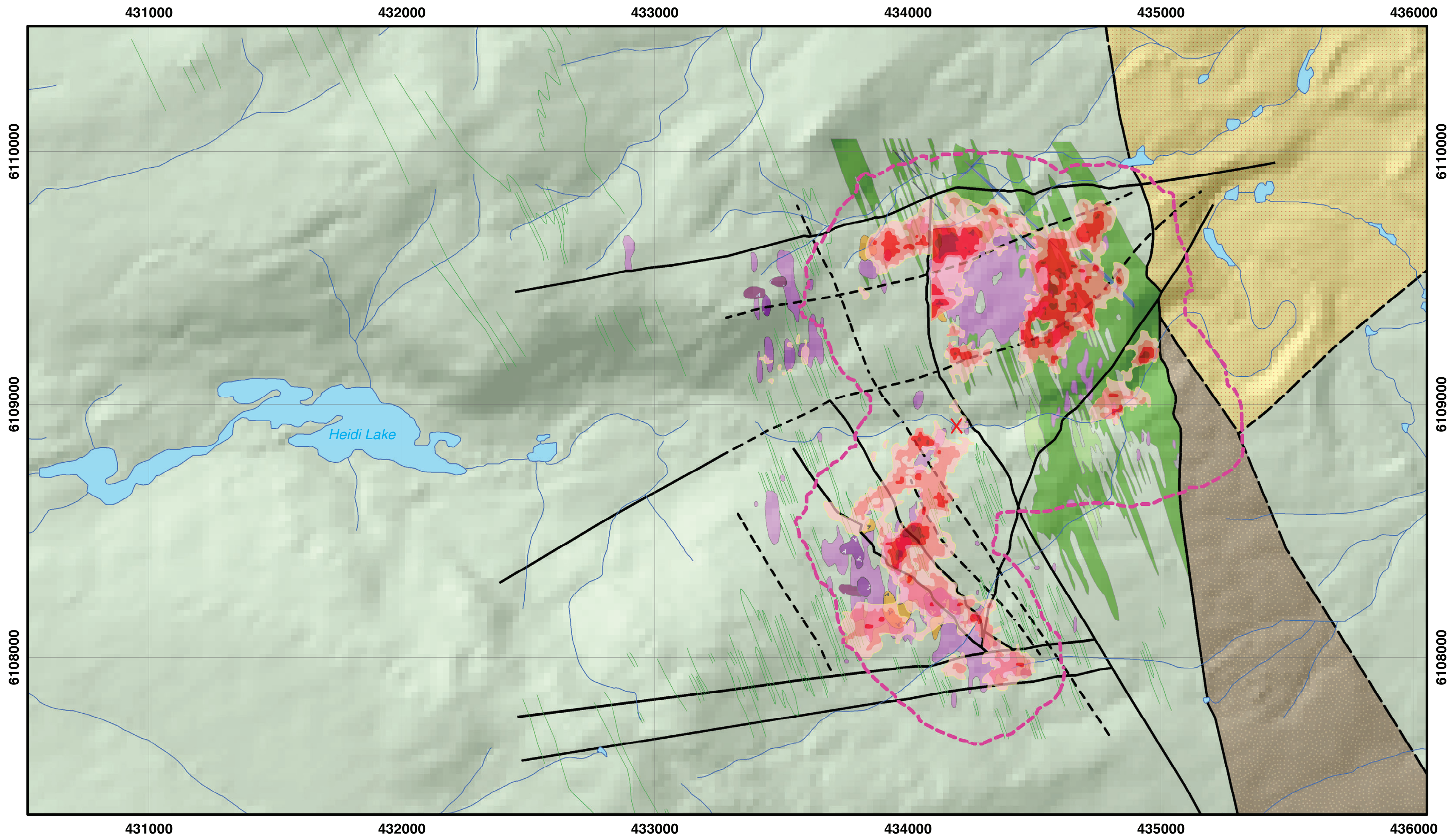
MT. MILLIGAN

A geo-exploration atlas of the Mt. Milligan porphyry copper-gold district

Geoscience BC

BEDROCK GEOLOGY with Cu & Au Grade Contours

1 : 20,000



Copper Grade Contours

(Centerra 2017, *in* Andrews et al., 2017)

Limit of Cu grade at 1010 bench level (projected to surface)

Cu (%)

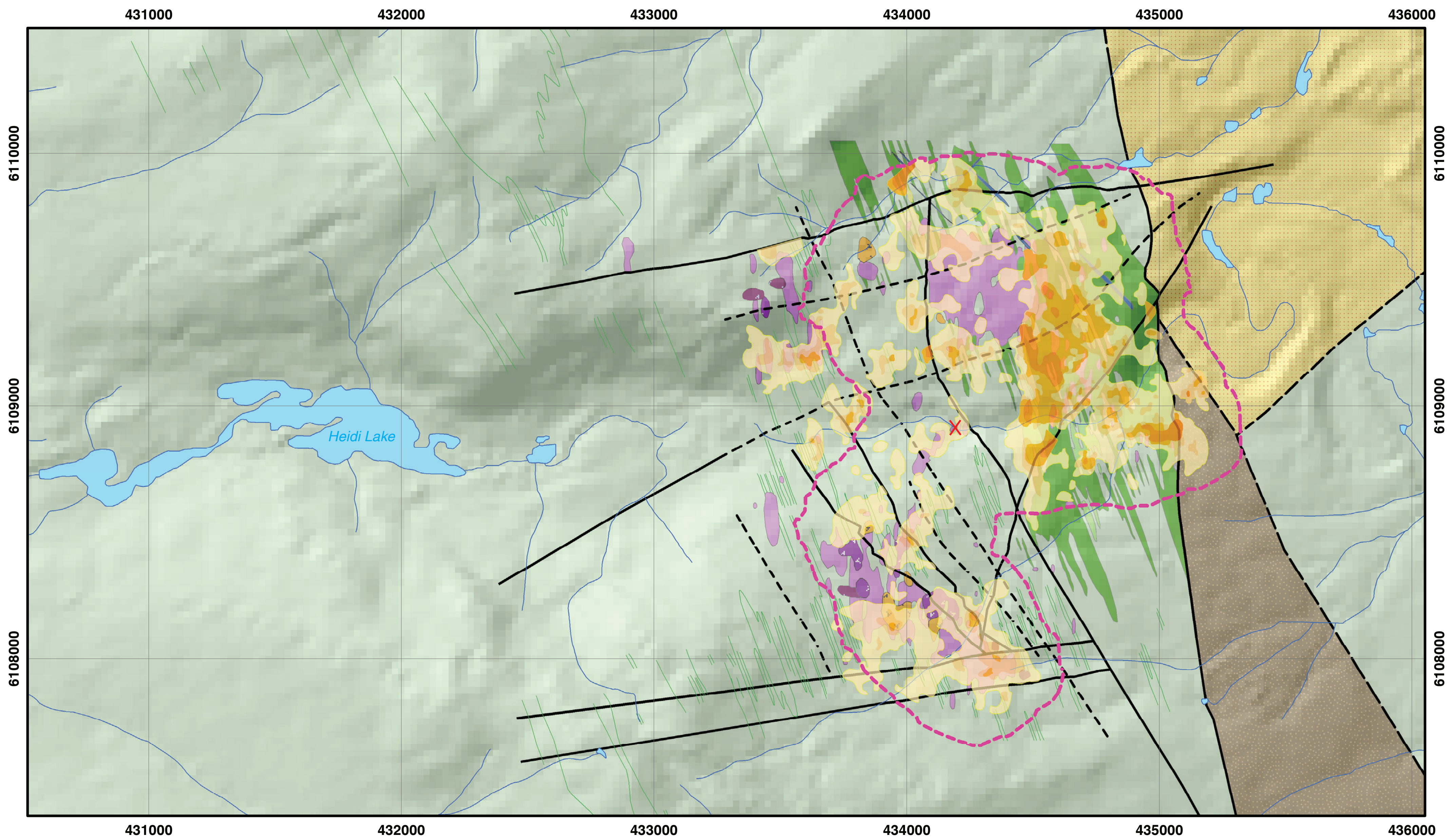
- > 0.40
- > 0.30
- > 0.20
- > 0.15

X Location of discovery outcrops: R. Haslinger in 1983

Mt. Milligan mine

(Centerra 2020, *in* Fitzgerald et al., 2020)

Ultimate pit outline



Gold Grade Contours

(Centerra 2017, *in* Andrews et al., 2017)

Limit of Au grade at 1010 bench level (projected to surface)

Au (gpt)

- > 1.0
- > 0.6
- > 0.4
- > 0.2

X Location of discovery outcrops: R. Haslinger in 1983

SCALE 1 : 20,000

0 1 2

kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

Data Sources:

Mt. Milligan deposit area:

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MT. MILLIGAN

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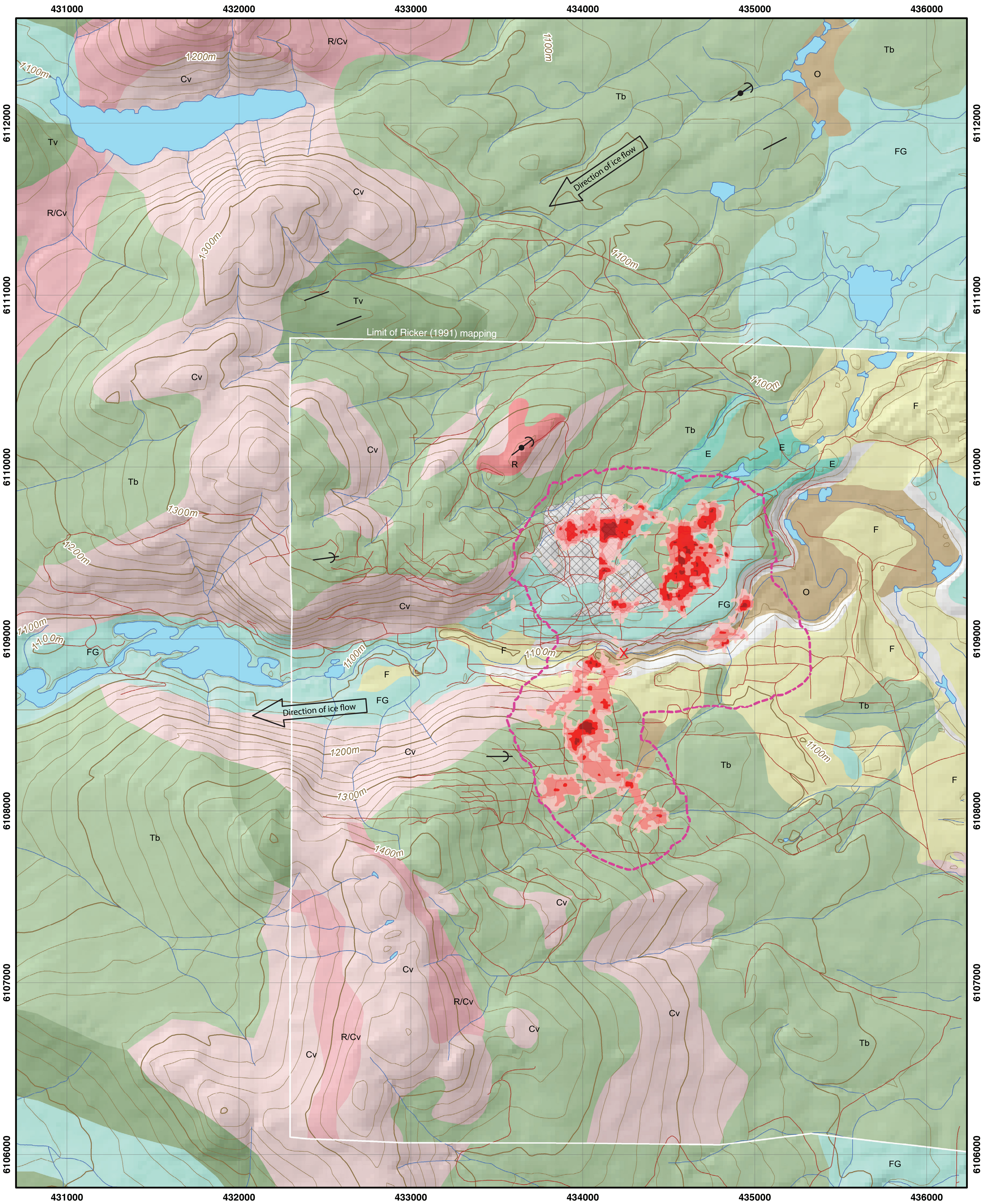
SURFICIAL GEOLOGY

1 : 20,000



Non-glacial environment

- Anthropogenic deposits
- O Organic deposits

Glacial and proglacial environment

- F Fluvial
- K Kettle
- E Esker
- FG Glaciofluvial
- Tv Till, morainal veneer
- Tb Till, morainal blanket

Bedrock and colluvium

- Cv Colluvium
- R/Cv Bedrock & colluvium
- R Bedrock

- U Undifferentiated

Ice Flow Indicators & Geological Features

- Drumlin, ice flow direction indicated
- Striae/grooves, ice flow direction indicated
- Undifferentiated lineations and flutings

Copper Grade Contours

(Centerra 2017, *in* Andrews et al., 2017)

Limit of Cu grade at 1010 bench level (projected to surface)

Cu (%)

- > 0.40
- > 0.30
- > 0.20
- > 0.15

X Location of discovery outcrops: R. Haslinger in 1983

Mt. Milligan mine

(Centerra 2020, *in* Fitzgerald et al., 2020)

Ultimate pit outline

SCALE 1 : 20,000

0 1 2

kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

Data Sources:

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Geology:

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Kerr, D.E. (1991): Surficial geology of the Mount Milligan Area; British Columbia Ministry of Energy, Mines and Petroleum Resources, Open File 1991-07, scale 1:50,000.

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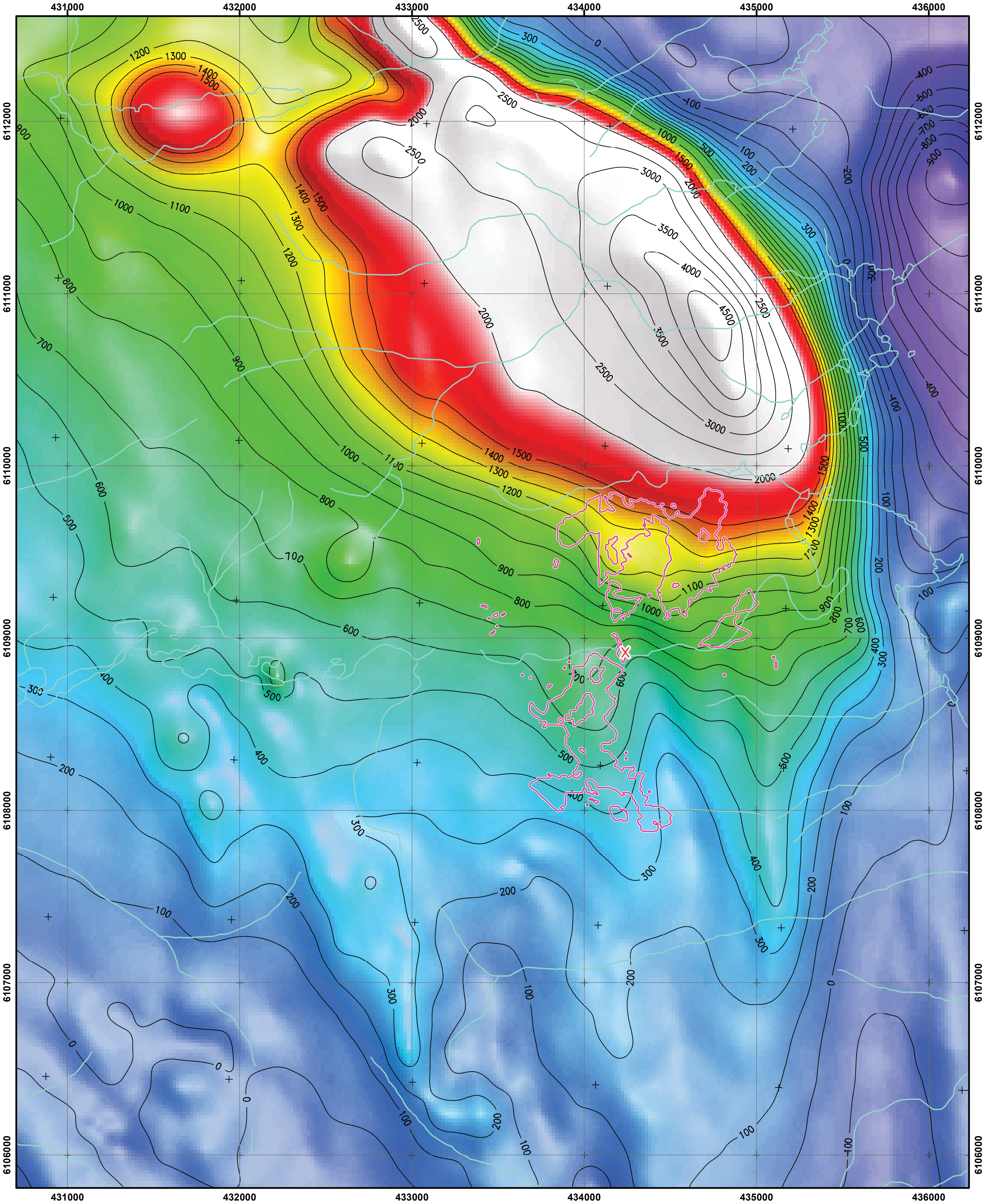
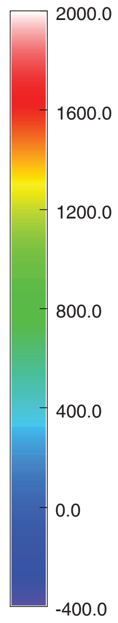
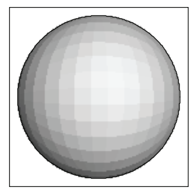
MAGNETICS
Residual Magnetic Intensity
1 : 20,000





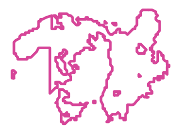
RMI (nT)



Azimuth : 45
Inclination : 75

X Area of discovery outcrops:
R. Haslinger in 1983.
Creek zone, now called Saddle zone

Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)



limit of
> 0.15 % Cu grade
1010 bench
(projected to surface)

SCALE 1 : 20,000

0 1 2
kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

Data Sources:

2008 VTEM survey:
Geotech Limited, 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 & 94C, D); Geoscience BC, Report 2008-04.

Data has been adjusted to a Residual Magnetic Intensity value to match the NRCAN national 200m grid.

Data range -967 nT to 4914 nT.

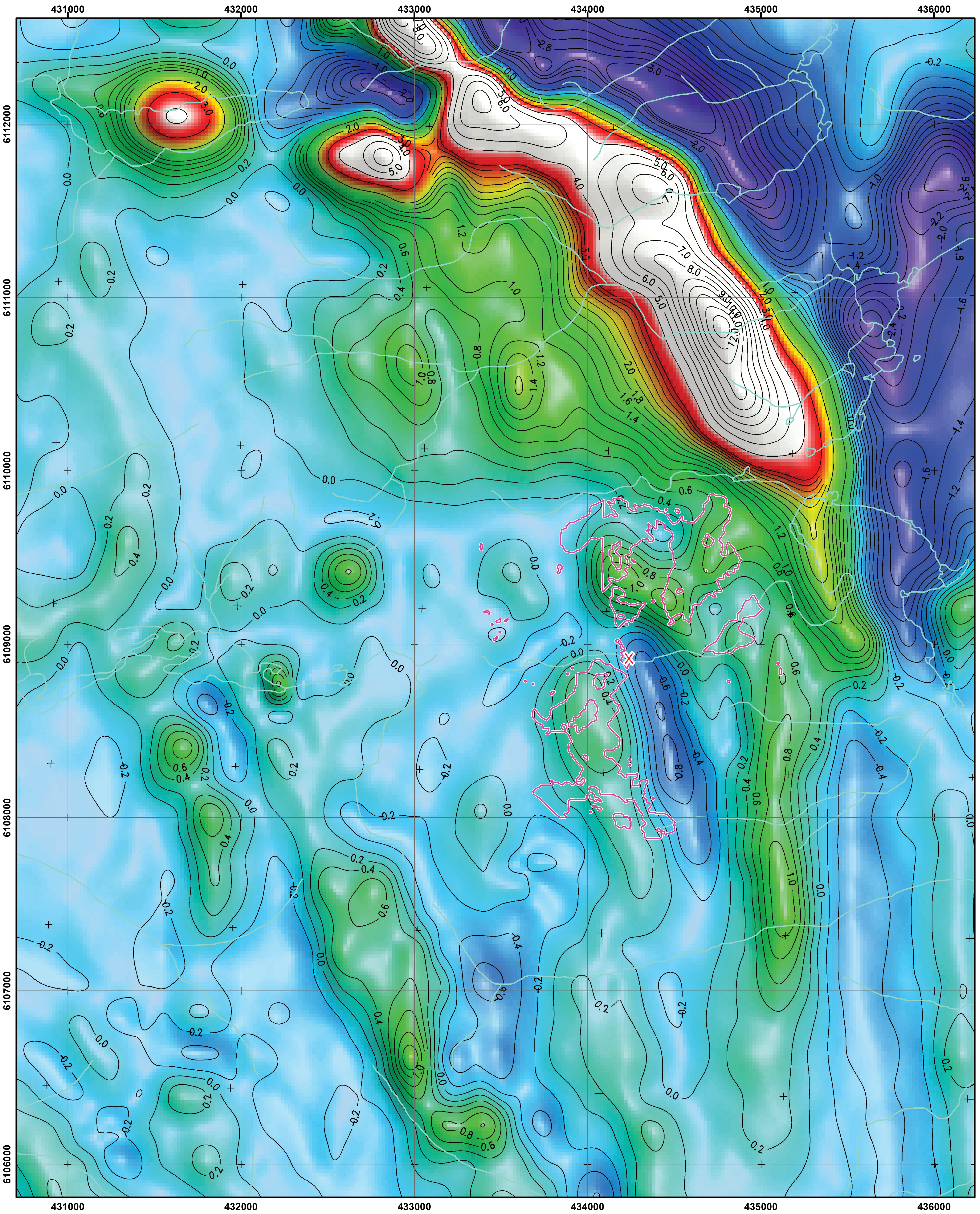
MT. MILLIGAN

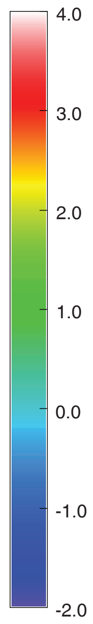
A geo-exploration atlas of the Mt. Milligan porphyry copper-gold district

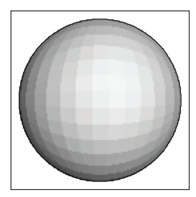
Geoscience BC

MAGNETICS
First Vertical Derivative

1 : 20,000



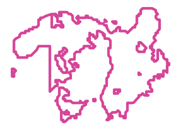




Azimuth : 45
Inclination : 75

X Area of discovery outcrops:
R. Haslinger in 1983.
Creek zone, now called Saddle zone

Mt. Milligan orebodies
(Centerra 2017, *in* Andrews et al., 2017)



limit of
> 0.15 % Cu grade
1010 bench
(projected to surface)

SCALE 1 : 20,000

0 1 2
kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

Data Sources:

2008 VTEM survey:
Geotech Limited, 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 & 94C, D); Geoscience BC, Report 2008-04.

First vertical derivative calculated from TMI data and upward continued 50 metres to improve anomaly shapes.

Data range -3.8 nT/m to 13.6 nT/m

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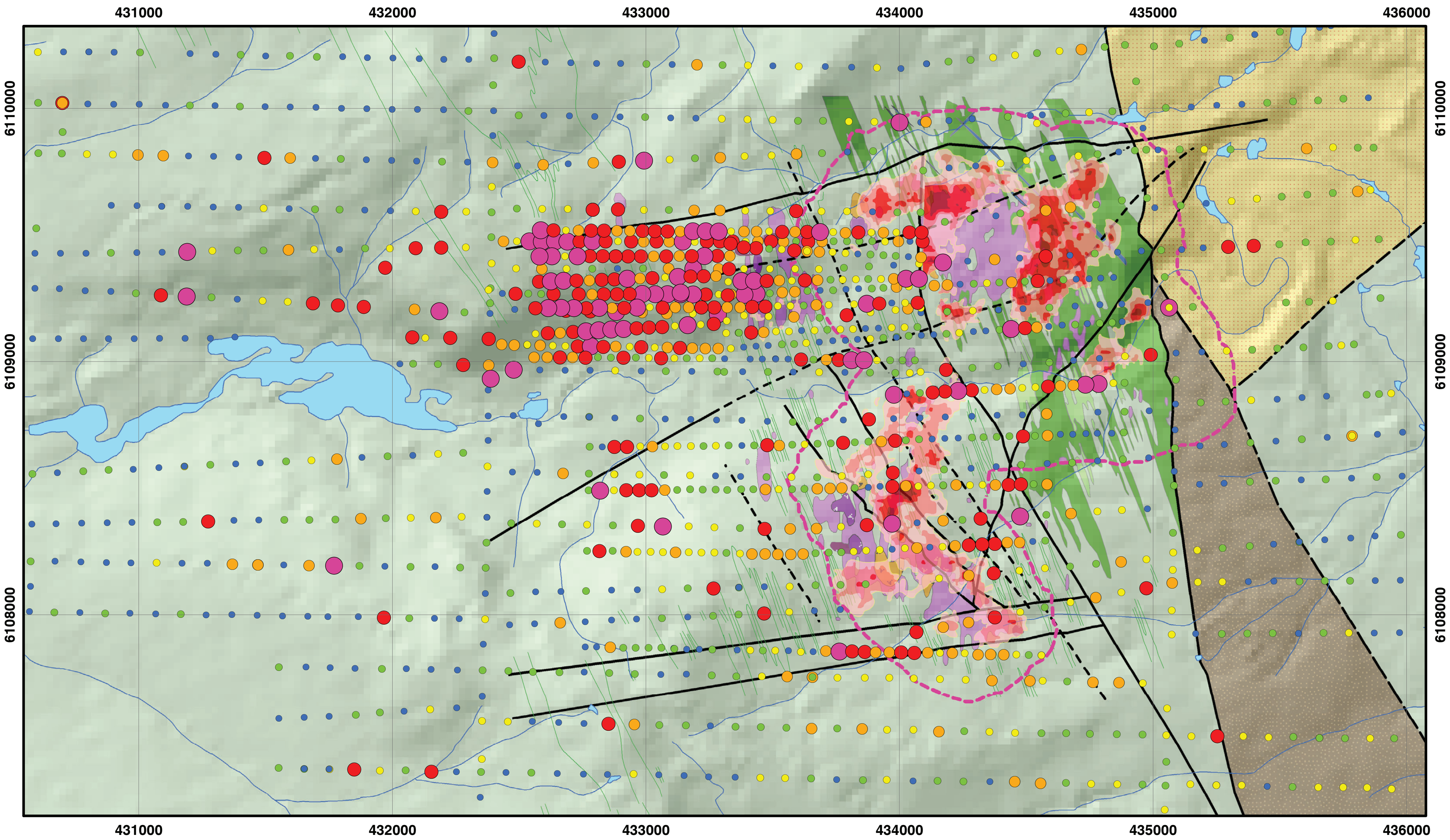
A geo-exploration atlas of the Mt. Milligan porphyry copper-gold district

Geoscience BC

GEOCHEMISTRY
Soils

1 : 20,000



Cu

ppm

- 0.0 - 36.0
- 36.1 - 68.7
- 68.8 - 116.0
- 116.1 - 193.0
- 193.1 - 394.0
- 394.1 - 5463.0

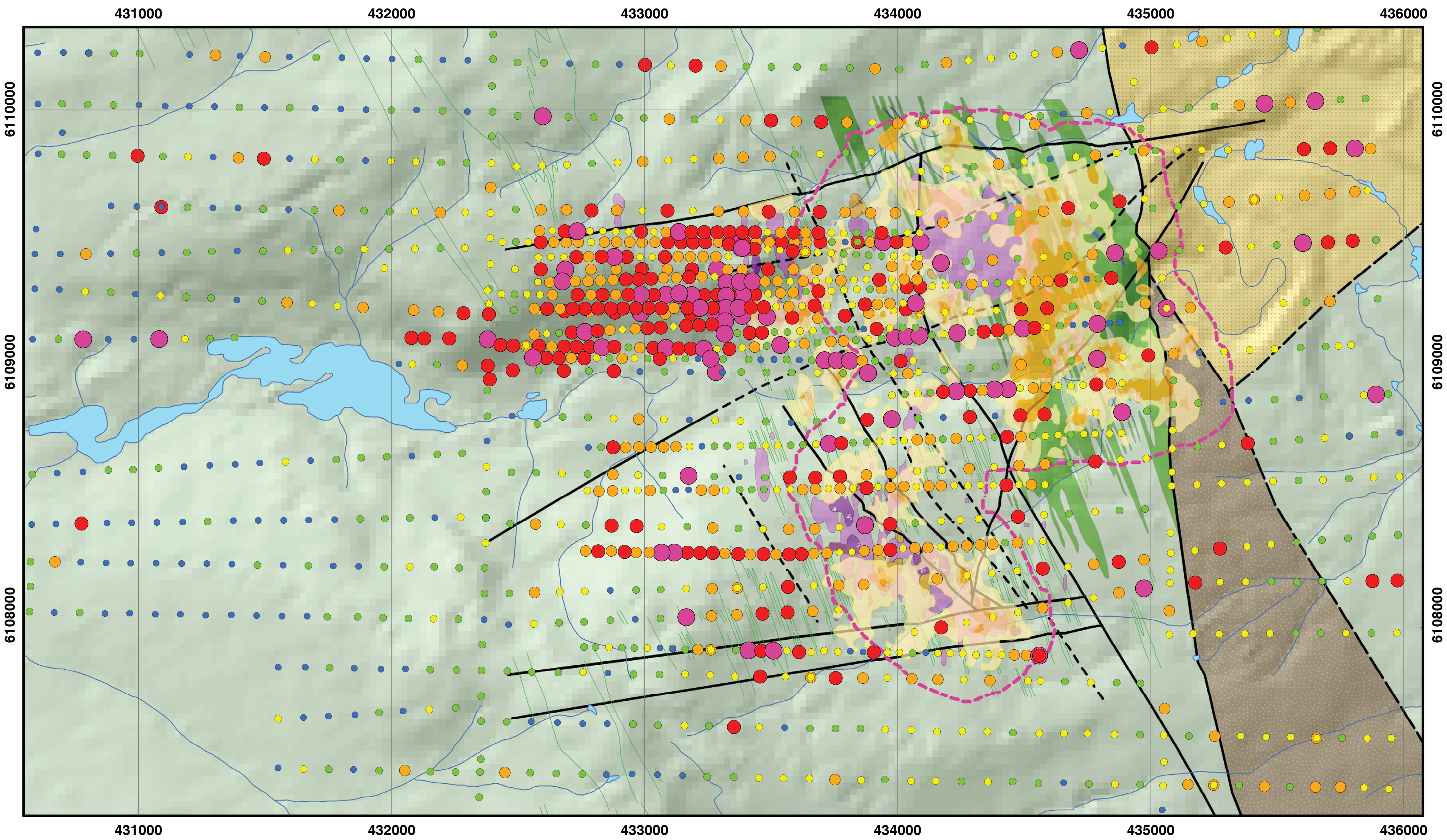
Copper Grade Contours

(Centerra 2017, *in* Andrews et al., 2017)

Limit of Cu grade at 1010 bench level (projected to surface)

Cu (%)

- > 0.40
- > 0.30
- > 0.20
- > 0.15



Au

ppb

- 0 - 5
- 6 - 21
- 22 - 45
- 46 - 75
- 76 - 235
- 236 - 19100

Gold Grade Contours

(Centerra 2017, *in* Andrews et al., 2017)

Limit of Au grade at 1010 bench level (projected to surface)

Au (gpt)

- > 1.0
- > 0.6
- > 0.4
- > 0.2

SCALE 1 : 20,000

0 1 2

kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

Data Sources:

See full references in reference list at end of atlas.

Farmer and Rebagliati (1984): BC Geological Survey Assessment Report 11951.
Heberlein et al. (1984): BC Geological Survey Assessment Report 12912.
Heberlein (2010): BC Geological Survey Assessment Report 31930.
Leriche and Bower (1990): BC Geological Survey Assessment Report 20227.
Myers et al. (1985): BC Geological Survey Assessment Report 13891.
Myers and Rebagliati (1985): BC Geological Survey Assessment Report 14377.
Peters (2011): BC Geological Survey Assessment Report 32703.

This compilation of soil sample surveys includes results from the 1980s, 1990, and 2010-2011. All soil sample preparation reported includes samples being dried and sieved to -80 mesh, with aqua regia digestion. The samples in the earlier surveys were analyzed by ICP-AES with gold by fire assay and AA. The more recent surveys moved to analysis by ICP-MS.

MT. MILLIGAN

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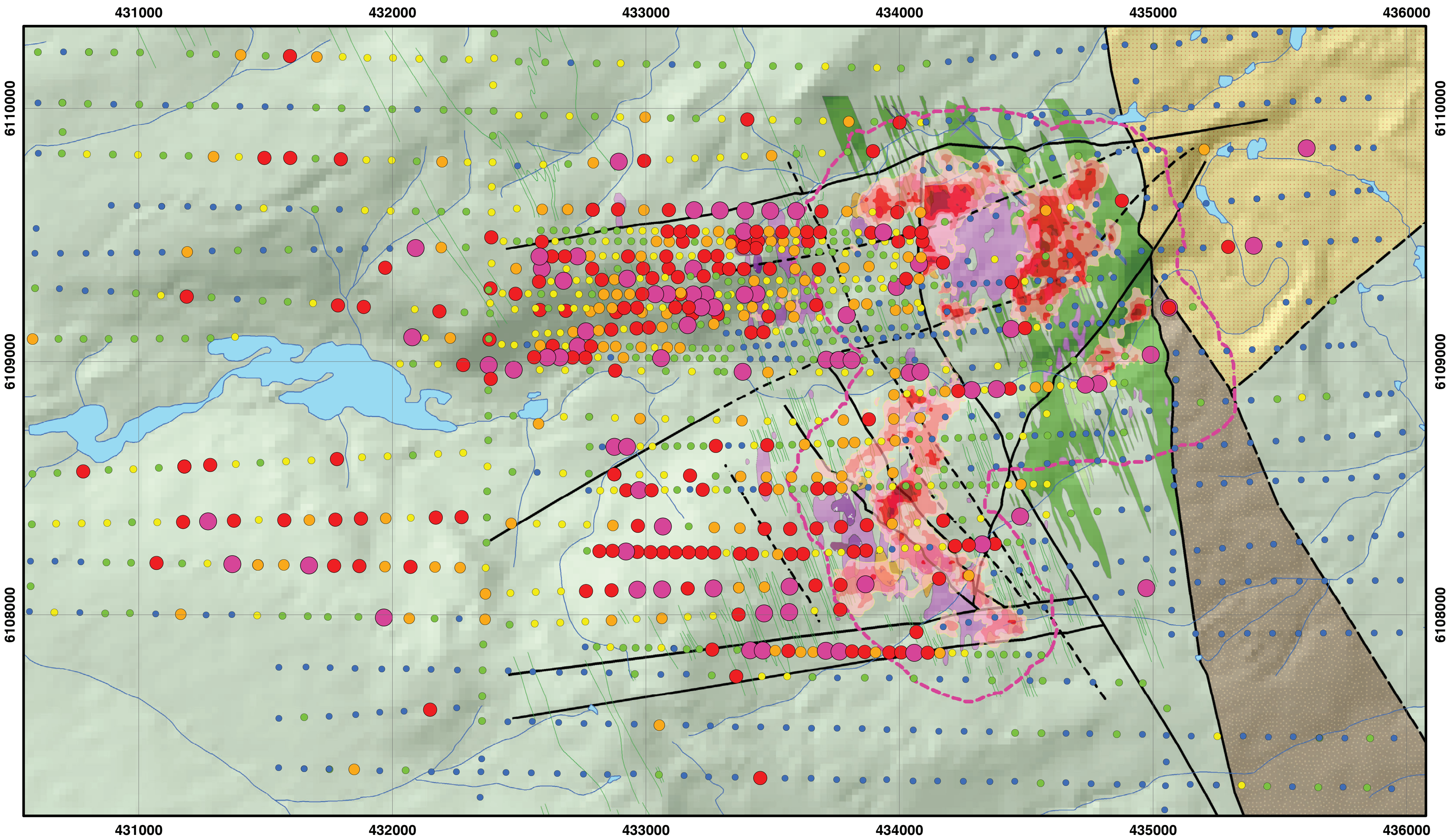
GEOCHEMISTRY
Soils

1 : 20,000



Mo

ppm

- 0.0 - 1.0
- 1.1 - 2.0
- 2.1 - 3.0
- 3.1 - 4.0
- 4.1 - 7.0
- 7.1 - 108.0

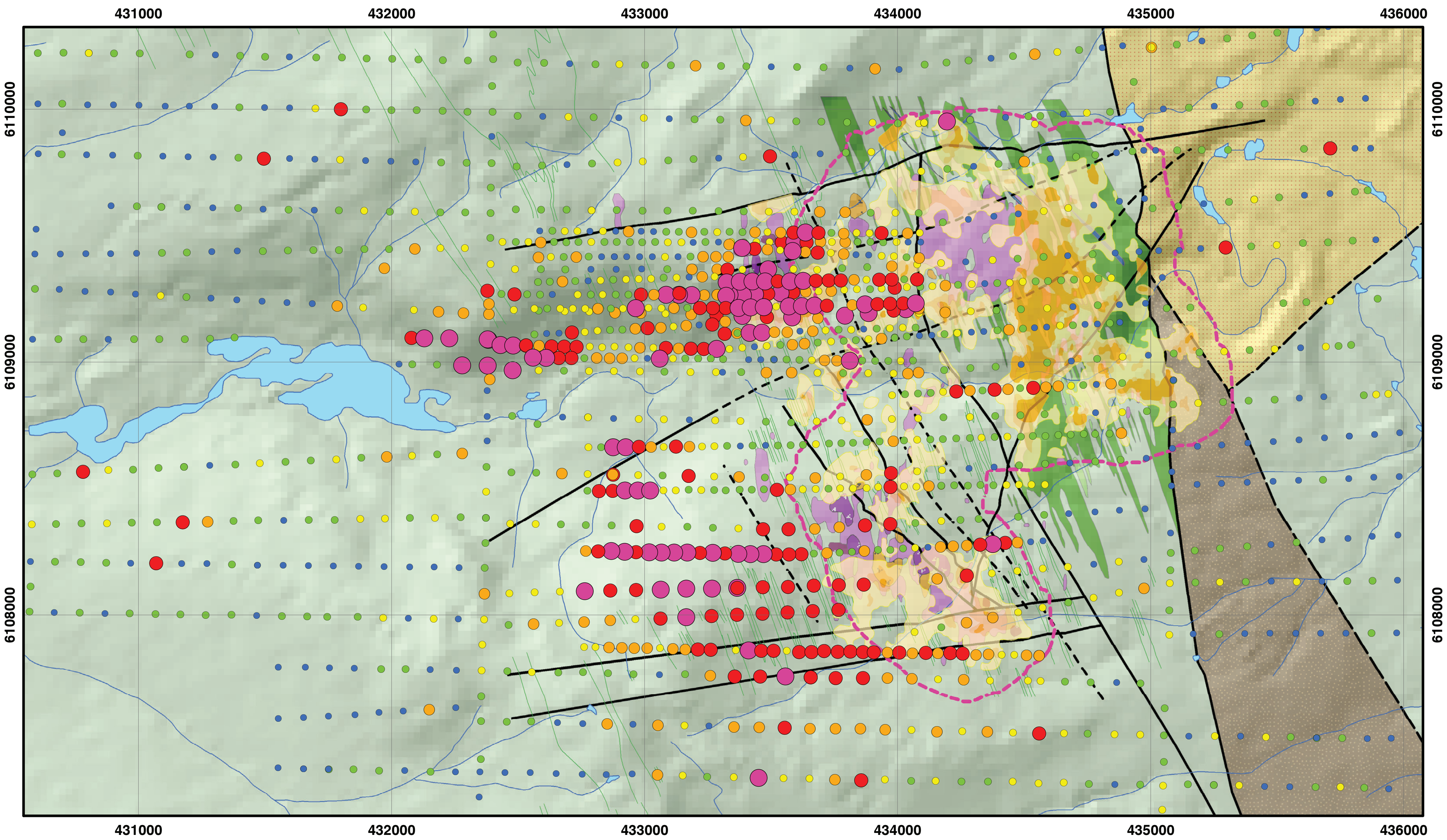
Copper Grade Contours

(Centerra 2017, *in* Andrews et al., 2017)

Limit of Cu grade
at 1010 bench level
(projected to surface)

Cu (%)

- > 0.40
- > 0.30
- > 0.20
- > 0.15



As

ppm

- 0.0 - 5.9
- 6.0 - 10.0
- 10.1 - 15.0
- 15.1 - 23.0
- 23.1 - 54.0
- 54.1 - 8654.0

Gold Grade Contours

(Centerra 2017, *in* Andrews et al., 2017)

Limit of Au grade
at 1010 bench level
(projected to surface)

Au (gpt)

- > 1.0
- > 0.6
- > 0.4
- > 0.2

SCALE 1 : 20,000

0 1 2
kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

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Myers and Rebagliati (1985): BC Geological Survey Assessment Report 14377.
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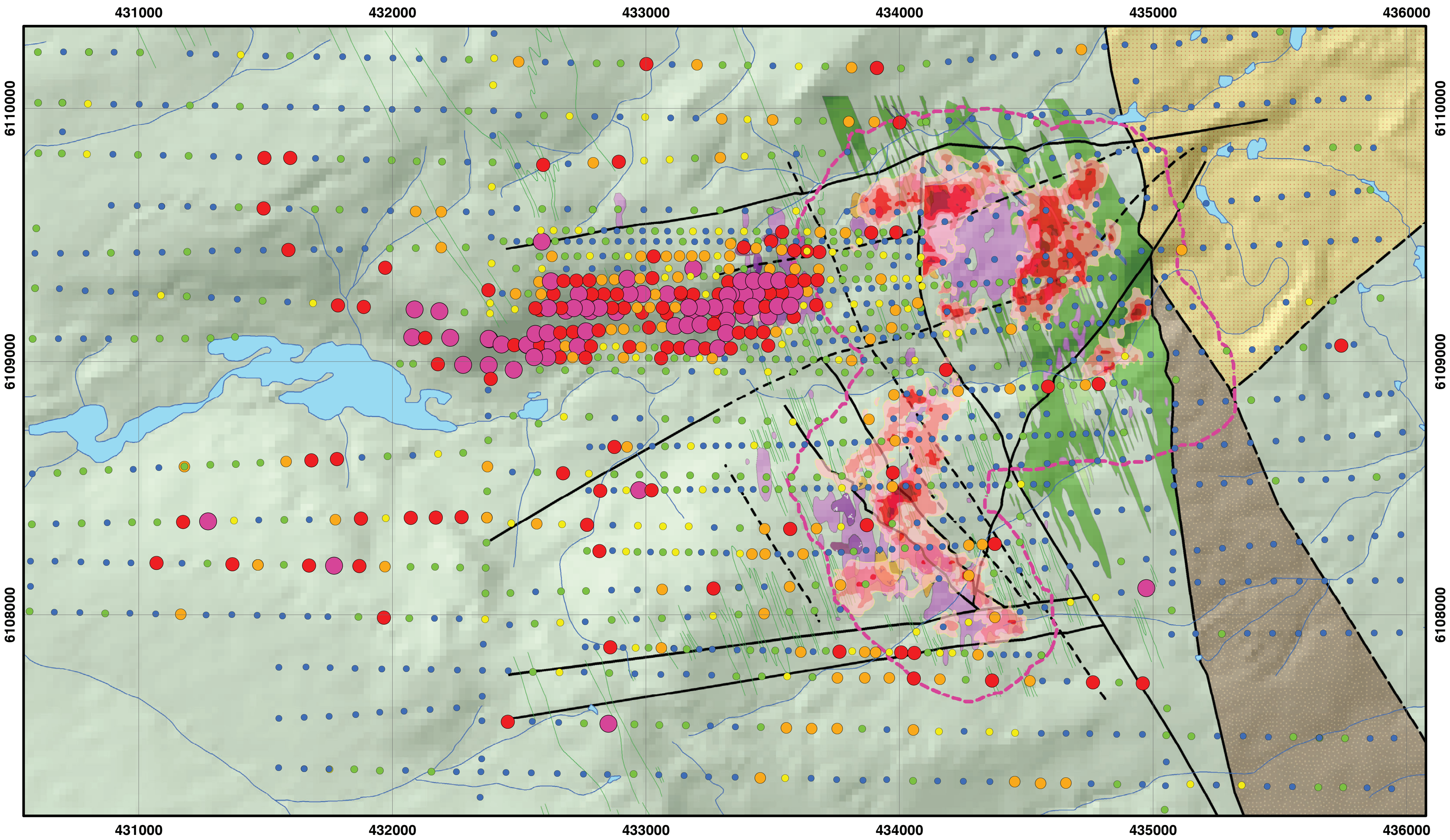
MT. MILLIGAN

A geo-exploration atlas of the Mt. Milligan porphyry copper-gold district

Geoscience BC

GEOCHEMISTRY
Soils

1 : 20,000



Co

ppm

- 0.0 - 8.1
- 8.2 - 11.0
- 11.1 - 13.9
- 14.0 - 16.9
- 17.0 - 27.0
- 27.1 - 127.0

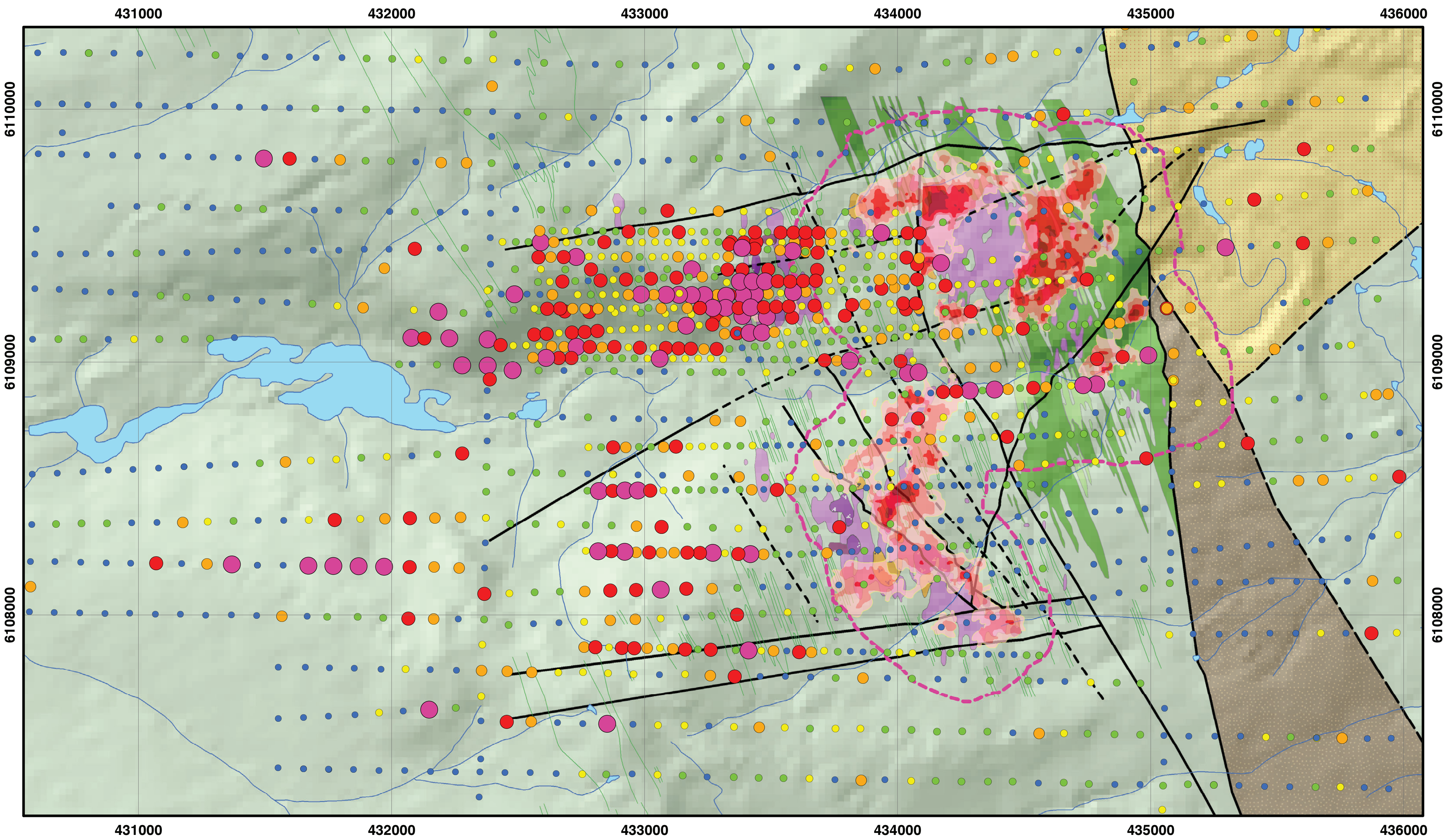
Copper Grade Contours

(Centerra 2017, *in* Andrews et al., 2017)

Limit of Cu grade
at 1010 bench level
(projected to surface)

Cu (%)

- > 0.40
- > 0.30
- > 0.20
- > 0.15



Fe

percent

- 0.00 - 3.48
- 3.49 - 4.29
- 4.30 - 4.92
- 4.93 - 5.48
- 5.49 - 6.90
- 6.91 - 16.75

Copper Grade Contours

(Centerra 2017, *in* Andrews et al., 2017)

Limit of Cu grade
at 1010 bench level
(projected to surface)

Cu (%)

- > 0.40
- > 0.30
- > 0.20
- > 0.15

SCALE 1 : 20,000

0 1 2

kilometres

Universal Transverse Mercator Projection
NAD 83 Datum, Zone 10

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Heberlein (2010): BC Geological Survey Assessment Report 31930.
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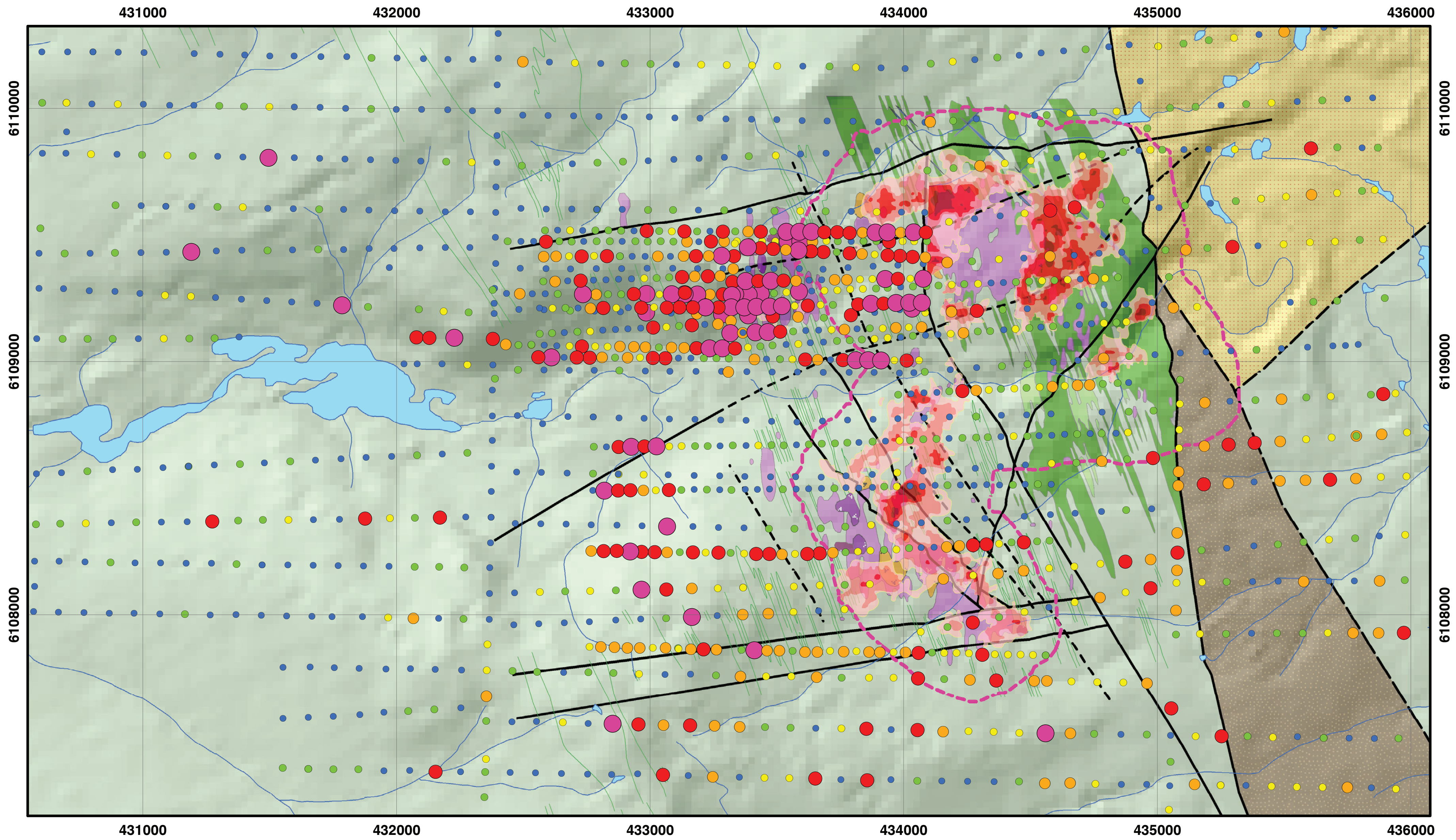
GEOCHEMISTRY
Soils
1 : 20,000



Pb

ppm

- 0.0 - 6.0
- 6.1 - 9.0
- 9.1 - 10.9
- 11.0 - 12.8
- 12.9 - 18.0
- 18.1 - 1585.0

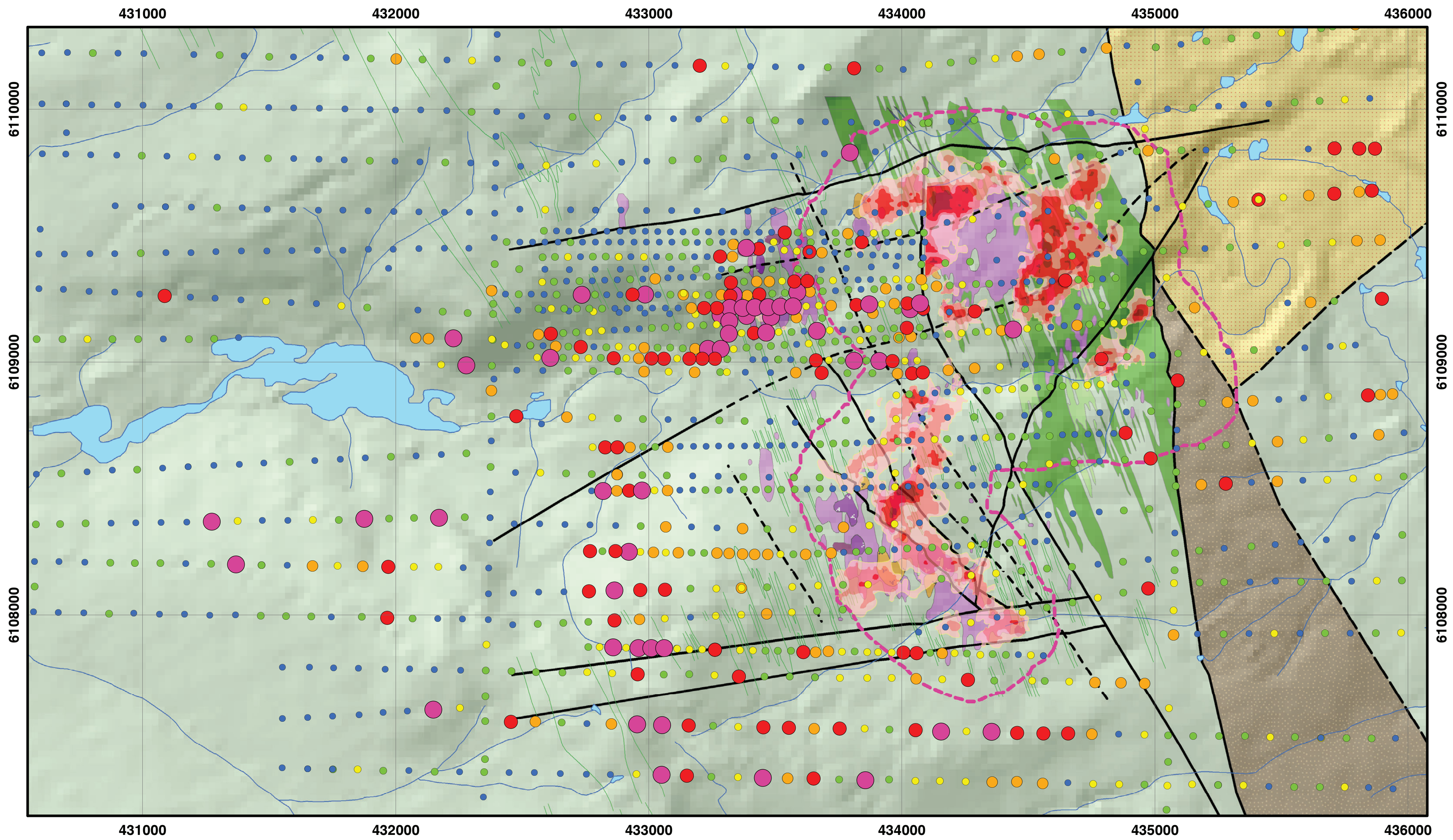
Copper Grade Contours

(Centerra 2017, *in* Andrews et al., 2017)

Limit of Cu grade
at 1010 bench level
(projected to surface)

Cu (%)

- > 0.40
- > 0.30
- > 0.20
- > 0.15



Zn

ppm

- 0.0 - 46.9
- 47.0 - 62.0
- 62.1 - 76.0
- 76.1 - 90.0
- 90.1 - 120.0
- 120.1 - 902.0

Copper Grade Contours

(Centerra 2017, *in* Andrews et al., 2017)

Limit of Cu grade
at 1010 bench level
(projected to surface)

Cu (%)

- > 0.40
- > 0.30
- > 0.20
- > 0.15

SCALE 1 : 20,000

0 1 2
kilometres

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