El Quevar Project
Saltar Province, Argentina
NI 43-101 Technical Report on Updated Mineral Resource Estimate

Prepared for:
Golden Minerals Company

Prepared by:
Mr Gordon Seibel, RM SME, Amec Foster Wheeler
Mr William Colquhoun, FSAIMM, Amec Foster Wheeler
Mr Warren Rehn, QP MMSA, Golden Minerals

Effective Date:
26 February, 2018

Project Number:
196410

CERTIFICATE OF QUALIFIED PERSON

I, Gordon Seibel, RM SME, am employed as a Principal Geologist with Amec Foster Wheeler E&C Services Inc.

This certificate applies to the technical report entitled "El Quevar Project, Saltar Province, Argentina, NI 43-101 Technical Report on Updated Mineral Resource Estimate" that has an effective date of 26 February, 2018 (the "technical report").

I am a Registered Member of the Society for Mining, Metallurgy and Exploration (#2894840). I graduated from the University of Colorado with a Bachelor of Arts degree in Geology in 1980. In addition, I obtained a Masters of Science degree in Geology from Colorado State University in 1991.

I have practiced my profession for 35 years, during which time I have been directly involved in the development of resource models and mineral resource estimation for precious metals mineral projects in North America, South America, Africa, and Australia since 1991.

As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 *Standards of Disclosure for Mineral Projects* ("NI 43–101").

I visited the El Quevar Project from 20 to 23 March 2018.

I am responsible for Sections 1.1, 1.2, 1.8, 1.10 to 1.13; Section 2; Section 3; Section 11; Sections 12.2 to 12.7; Section 14; Sections 25.1, 25.6, 25.7; Sections 26.1, 26.2.1 to 26.2.2, 26.3; and Section 27 of the technical report.

I am independent of Golden Minerals Company as independence is described by Section 1.5 of NI 43–101.

I have no previous involvement with the El Quevar Project.

I have read NI 43–101 and the sections of the technical report for which I am responsible have been prepared in compliance with that Instrument.

As of the effective date of the technical report, to the best of my knowledge, information and belief, the sections of the technical report for which I am responsible contain all scientific and technical information that is required to be disclosed to make those sections of the technical report not misleading.

Dated: 13 April, 2018

"Signed and stamped"

Gordon Seibel, RM SME.

CERTIFICATE OF QUALIFIED PERSON

I, William Colquhoun, FSAIMM, am employed as a Principal Metallurgical Consultant with Amec Foster Wheeler (Perú) S.A. (Amec Foster Wheeler)

This certificate applies to the technical report entitled "El Quevar Project, Saltar Province, Argentina, NI 43-101 Technical Report on Updated Mineral Resource Estimate" that has an effective date of 26 February, 2018 (the "technical report").

I am a Fellow of the South African Institute of Metallurgy and a registered Professional Engineer of the Engineering Council of South Africa. I graduated from Strathclyde University with a Bachelor of Science Degree in Chemical and Process Engineering in 1982.

I have practiced my profession for 32 years. I have been directly involved in mining and gold processing operations, metallurgical consulting and engineering studies in Africa, Europe, Australia, Far East and North and South America including Peru.

As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 *Standards of Disclosure for Mineral Projects* ("NI 43–101").

I have not visited the El Quevar Project.

I am responsible for Sections 1.1, 1.2, 1.9, 1.13; Sections 2.1 to 2.3, 2.6; Section 13; Section 25.5; Section 26.2.3; and Section 27 of the technical report.

I am independent of Golden Minerals Company as independence is described by Section 1.5 of NI 43–101.

I have no previous involvement with the El Quevar Project.

I have read NI 43–101 and the sections of the technical report for which I am responsible have been prepared in compliance with that Instrument.

As of the effective date of the technical report, to the best of my knowledge, information and belief, the sections of the technical report for which I am responsible contain all scientific and technical information that is required to be disclosed to make those sections of the technical report not misleading.

Dated: 13 April, 2018

"Signed"

William Colquhoun, FSAIMM.

CERTIFICATE OF QUALIFIED PERSON

I, Warren Rehn, QPMMSA, am employed as the President, Chief Executive Officer and Director, Golden Minerals Company (Golden Minerals).

This certificate applies to the technical report entitled “El Quevar Project, Saltar Province, Argentina, NI 43-101 Technical Report on Updated Mineral Resource Estimate” that has an effective date of 26 February, 2018 (the “technical report”).

I am a QP member of MMSA with member number 01449QP since 2012. I hold a MS in Geology from Colorado School of Mines dated 1983 and a BS in Geological Engineering from the University of Idaho dated 1978.

I have practiced my profession for more than 34 years. I have been directly involved in planning, reviewing, interpreting, and supervising the exploration of the El Quevar project since 2012.

As a result of my experience and qualifications, I am a Qualified Person as defined in National Instrument 43–101 *Standards of Disclosure for Mineral Projects* (“NI 43–101”).

I last visited the El Quevar Project from 20 to 23 March 2018.

I am responsible for Sections 1.1 to 1.7; Sections 2 to 10, Section 12.1; Sections 15 to 24; Sections 25.1 to 25.4, 25.7; and Section 27 of the technical report.

I am not independent of Golden Minerals Company as independence is described by Section 1.5 of NI 43–101.

I have worked on aspects of the El Quevar Project since March 2012.

I have read NI 43–101 and the sections of the technical report for which I am responsible have been prepared in compliance with that Instrument.

As of the effective date of the technical report, to the best of my knowledge, information and belief, the sections of the technical report for which I am responsible contain all scientific and technical information that is required to be disclosed to make those sections of the technical report not misleading.

Dated: 13 April, 2018

“Signed”

Warren Rehn, QPMMSA.

IMPORTANT NOTICE

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1.0 SUMMARY

1.1 Introduction

Amec Foster Wheeler E&I Services, Inc., a Wood company (Wood) has prepared a technical report (the Report) for Golden Minerals Company (Golden Minerals) on the El Quevar Project (the Project) located in the Salta Province of Argentina.

1.2 Terms of Reference

The Report was prepared to support disclosure of an updated Mineral Resource estimate in the news release dated 28 February 2018, entitled “Golden Minerals Announces New Resource Estimate at El Quevar’s Yaxtché Deposit”.

1.3 Project Setting

The El Quevar Project is located in northwestern Argentina, approximately 300 km northwest of the provincial capital of Salta, within the San Antonio de los Cobres municipality, Salta Province.

The Project is accessed from Salta by following National Road 51 (NR51) to the turnoff to Provincial Road 27 (PR27) for approximately 226 km. From Salta to San Antonio de los Cobres, NR51 consists of either a paved or well-maintained gravel surface. Beyond San Antonio de los Cobres, NR51 is a well-maintained gravel road to the junction with PR27. From the intersection, the El Quevar Project is accessed by driving south for approximately 30 km to the junction with the access road and then east, with the camp currently located approximately 10 km from the junction. Driving time from Salta to the Project camp is four to five hours.

The climate is characteristic of high mountain environments. The weather is extremely dry and ranges from polar conditions on the higher mountain peaks to arid steppe environments at the valley floors. It is expected that any future underground mining operations will be conducted year-round. Exploration activities can be temporarily curtailed by rainfall or snow especially during winter months.

Most of the mineralized areas are located between 4,500 and 5,100 m above sea level, with the Yaxtché zone surface exposures located between 4,800 and 4,900 m. Vegetation is characteristic of steppe climates. Wildlife is rare due to the altitude and aridity.

Salta is the major regional supply centre and has all major services.

The 210,000 m^3/d high-pressure Gasoducto Minero natural gas pipeline passes through the Project area, about 5 km west of the exploration camp. Gas is available for mining projects in Salta Province.

Grid electricity is potentially available from a 354-kV high-voltage power line, owned by Termo Andes, which passes 30 km north of Yaxtché (no spare capacity at present). There is currently no external electric power to El Quevar. Power to the exploration camp is supplied by two 275 kVA diesel generators.

Water for camp use is pumped from a well.

The exploration camp is rated for 96 persons.

Manpower can be sourced for exploration activities in the Province.

1.4 Mineral Tenure, Surface Rights, Water Rights, Royalties and Agreements

The El Quevar Project consists of 31 exploitation concessions (approx. 57,000 ha). Providing certain obligations are met, including annual canon payments, the concessions are granted indefinitely. Concessions are held in the name of Silex Argentina S.A. (Silex Argentina), a wholly indirectly-owned subsidiary of Golden Minerals.

Surface rights at the El Quevar Project are owned by the province of Salta, and as a result there are no agreements required for access. The El Quevar area has no existing private properties or other infrastructure that would limit exploration activities. Golden Minerals holds seven easements, granted by the Province of Salta, which cover items such as, road access, power, water, and the camp and other infrastructure sites.

Silex Argentina has applied for both surface and underground water concessions which are currently pending.

A 1% net smelter return (NSR) royalty is payable on the value of all minerals extracted from the El Quevar II concession and a 1% NSR royalty on one-half of the minerals extracted from the Castor concession. Golden Minerals can purchase one half of the combined royalty interests for US $1 million in the first two years of production.

Golden Minerals may also be required to pay a 3% royalty to the Salta Province based on the mine mouth value of minerals extracted from any of the concessions, unless new legislation is enacted by the Argentine Federal Congress which will allow Salta Province to levy up to 3% royalty of the gross revenue accrued in a year.

All previous work was completed under fully authorized permits. Silex Argentina maintains the required environmental permits. These permits must be renewed every two years. New permits will be obtained as needed for exploration and further development work. A program of surface water sampling and reporting is in place as a condition for the ongoing environmental permits.

There are artisanal prospecting pits and minor workings within the Project area. There is an expectation that there will be environmental liabilities associated with the artisanal and small-scale mining activity. Golden Minerals has initiated reclamation activities on some of the historical disturbances.

The Project lies completely within the Andean Natural Reserve Zone (La Reserva Natural Los Andes) which is classified as a multi-use area (Categoría de Manejo de Uso Múltiple VIII). This classification allows for production/extraction activities including exploration and mining.

1.5 Geology and Mineralization

The El Quevar Project is located along the southern margin of the Miocene Altiplano-Puna volcanic complex of the Andean Central Volcanic Zone, within the Quevar volcanic complex (QVC). The QVC sits within a northeast-trending belt of Quaternary stratovolcanoes and associated domes. The Yaxtché deposit has been identified within the Quevar South alteration zone.

In the Yaxtché deposit area, an epiclastic unit consisting of a matrix-supported volcanic breccia is intruded by a complex of porphyritic dacite domes and associated breccias and flows. A series of dacite–andesite flows cap the volcanic succession and form prominent ridges in the Quevar South area. Hydrothermal breccias have been widely reported in Yaxtché drill holes and outcrop intermittently across the deposit area.

The Yaxtché structural trend strikes at approximately 292° and dips to the north at 65° to 70° near surface, shallowing to 45° to 55° at depth. Due to the geometry of the zone, the structure has been interpreted to represent a listric fault. A series of northeast–southwest-trending structures cut through the deposit area and were largely identified during underground development.

Zoned advanced argillic alteration is typical of that which might be expected to occur in association with high-sulphidation epithermal gold deposits.

Mineralization at Yaxtché consists of fine-grained black sulphides and sulphosalts, occurring as disseminations, open-space filling, and in massive veinlets or clots. Mineralization is controlled primarily by zones of high paleo-permeability. Silver is the element of economic significance, and anomalous concentrations of copper, lead, zinc, and lesser gold occur locally. Mineralization is classified by oxidation state:

- Oxide (supergene): plumbojarosite, argentojarosite, limonite, stibiconite
- Mixed (secondary enrichment): chalcocite, covellite, argentite, native silver, chlorargyrite: when rimming hypogene sulphides
- Sulphide (hypogene): pyrite, galena, sphalerite, tetrahedite–tennantite, complex Pb–Sb–Bi ± Ag sulphosalts, bismuthinite, stibnite, chalcopyrite.

The Yaxtché deposit alteration assemblages are typical of high sulphidation epithermal deposits, whereas the metal content and sulphide assemblages are characteristic of mineralizing fluids with an intermediate sulphidation state.

The Yaxtché deposit remains open along strike and several areas adjacent to the resource estimate area have returned significant silver intercepts. Deeper drill holes at Yaxtché West extension show that significant widths and grades of silver mineralization continue down plunge on the Yaxtché trend.

Within the greater Quevar South project area, several additional prospects have been identified and remain to be fully tested.

1.6 History

Prior to Golden Minerals' property interest, exploration activities had been conducted by Fabricaciones Militares, BHP-Utah Minerals International, Industrias Peñoles, Minera Hochschild, Mansfield Minerals, and Apex Silver Mines Corporation/ Apex Silver Mines Limited (Apex Silver) in the period from 1971–2008.

Work completed included geological mapping, surface channel, panel and rock chip sampling, ground induced polarization (IP)/resistivity geophysical surveys, trenching, petrographic examination, reverse circulation (RC) and diamond core drilling, initial metallurgical testwork, and completion of an initial Mineral Resource estimate.

Golden Minerals acquired an interest in the Project in 2009. Work conducted has included:

- Geological mapping: surface 1:2,000 scale that was compiled at 1:5,000; underground mapping at 1:50 and 1:100 scale and compiled at 1:500 scale
- Collection of 3,100 surface samples
- Reprocessing and interpretation of the 2007–2008 IP survey
- Construction of an adit and decline to access the eastern part of the Yaxtché zone and to investigate the continuity of the mineralization by drifting, channel sampling and bulk sampling of development rounds
- Petrographic, mineralogical, X-ray diffraction, passive infrared mineral analyzer (PIMA), and automated mineralogy analysis examinations
- Additional core drilling
- Metallurgical tests
- Updated Mineral Resource estimates.

1.7 Drilling and Sampling

Two drill programs were completed by Fabricaciones Militares and BHP-Utah Minerals International in the 1970s. Six to seven drill holes appear to have been completed, but metreages are not known. There is no other available information on these programs.

Apex Silver and Golden Minerals completed drill campaigns from 2006–2013. These programs total 417 holes for 104,163 m. There has been no drilling on the Project since 2013.

Core has primarily been drilled at HQ size (63.5 mm core diameter). Occasional reductions to NQ size (47.6 mm) occurred in areas of poor ground conditions. Two drill holes of PQ size (85 mm diameter) were completed in 2011.

Geological logging was typically completed on paper sheets and later transferred to a database. The paper log had sections for comments and a graphic log with a separate area for drawing fractures. Mineralization, alteration and alteration intensity were recorded on the log sheet and there was an area for sample interval, sample number and analytical results. The geologist marked the core for any additional observations; for example, some of the early logging programs included PIMA measurements. A paper file was maintained for each stored drill hole with a checklist for each item that must be completed for every hole and included in the file. This included a hole summary, geological log, geotechnical log, analytical results, drill reports, certificate from the surveyor, photographs, downhole survey information and density measurements. Core was photographed.

Geotechnical information such as recovery, rock quality designation (RQD) and mechanical and physical fracture frequency was recorded.

Between April and August of 2012, 113 drill holes in the Yaxtché zone were re-logged on 29 cross sections spaced about 50 m apart, spanning the Yaxtché area. The purpose of the re-logging program was to standardize logging codes and facilitate reinterpretation of the Yaxtché zone.

The average core recovery for all El Quevar Project drill holes averages 93.9% for over 30,000 measured intervals.

Drill sites were located using a handheld global positioning system receiver (GPS). Yaxtché drill holes from the 2006–2008 and 2009 campaigns were surveyed by PDOP Servicios Topograficos (PDOP). PDOP used a Trimble model R3 GPS and a Trimble model M3 total station instrument for drill collar surveying. After 2009, surveys were competed by a surveyor who was an employee of Golden Minerals also using the Trimble model R3 GPS and a Trimble model M3 total station instrument.

Down-hole surveys were taken at 25 m intervals during the 2008–2012 campaigns, using either a Reflex Photobor or Sperry Sun instrument. During the 2012–2013 campaign, readings were at 25–50 m intervals, and performed using a Reflex magnetic survey tool.

Most holes in the Yaxtché deposit were drilled so as to cross-cut the mineralized zone at a high angle in terms of dip, and nearly all holes were at right angles to the strike of the mineralized Quevar structure. Due to the nature of the mineralization occurring as shoots and veins, the true width of the mineralization will vary both along strike and in the down dip direction. In areas where the strike and dip of the mineralization are well established, a true width for the mineralized intersection may be estimated. However, in areas of poor surface exposure or where there is no drilling or poor drilling, the true width of the mineralization cannot be estimated.

The entire mineralized zone was sampled, and 2 to 3 m shoulder was sampled on either side of the mineralized zone. Generally, the core sample intervals were a nominal 1 m length within the mineralized zone, but could be longer or shorter due to a lithological boundary. Outside the mineralized zone, samples were typically 2 m in length.

Golden Minerals conducted an extensive 1 m, chip–channel sampling program in the adit/decline and associated underground workings. The sampling consisted of chip–channels cut at the mining face, in the roof, ribs, and fault zone as exposed in the workings.

Density determinations were completed on unwaxed core samples using the water displacement method.

Laboratories used during the drill and sampling campaigns were independent of Apex Silver and Golden Minerals, and included Alex Stewart (ISO 9001:2000 accredited), ALS Chemex, Chile (ISO 9001:2000; Instituto Nacional de Normalizacion Chile ISO 17025.Of2005), Acme (IRAM – RI 9000-t 295), TSL Laboratories Inc. (ISO/IEC Standard 17025 Guidelines), SGS (ISO 9001; ISO/IEC Standard 17025 Guidelines) and American Assay Laboratories (ISO/IEC 17025:2005).

Sample preparation at Alex Stewart consisted of crushing to 80% passing 10 mesh, and pulverizing to 85% passing 200 mesh. The samples were analyzed for 39 elements by inductively coupled plasma (ICP); method ICP-MA-390) with four acid digestion of a 0.2 g sample. All samples were analyzed for silver and gold by fire assay of a 50 g sample with gravimetric finish for silver (method AG4A-50) and atomic absorption (AA) finish for gold (method Au450).

Sample preparation at ALS Chemex consisted of crushing to 70% passing 10 mesh, then pulverizing to 85% passing 200 mesh. Samples were analyzed for 33 elements by ICP (ME-ICP61) using four acid digestion. Silver over-limits were analyzed by fire assay with AA finish (Ag-AA62). Gold was analyzed by fire assay with AA finish (Au-AA24).

Sample preparation at Acme consisted of crushing to 80% passing 10 mesh and pulverizing to 85% passing 200 mesh. Samples were analyzed for 39 elements by ICP-MS (Group 1DX) analysis. Silver over-limits were analyzed by gravimetric finish (AG-G6-Grav). Gold was analyzed using method Au-GRA22.

Less than 1% of the samples in the database were sent to SGS. Samples were analyzed for 39 elements by ICP-MS (Group IDX) analysis. The silver over-limit analyses were analyzed by fire assay with gravimetric finish (AG-G6 -Grav). Gold was analyzed using Au-GRA22). Over-limit samples of lead, zinc, and copper are analyzed by 7AR with a multi-acid digestion.

No internal quality assurance and quality control (QA/QC) program was in place until drill hole QVD-043. The early analytical programs rely upon the internal Alex Stewart laboratory QA/QC program. The QA/QC program instigated by Apex Silver could use two types of blanks, three types of duplicates, six precious metal standard reference samples (SRMs) and four base metal SRMs. The sampling completed under Golden Minerals continued with the same insertion rates and materials as the Apex Silver programs.

Sample security procedures met industry standards at the time the samples were collected. Current sample storage procedures and storage areas are consistent with industry standards.

1.8 Data Verification

Data verification was undertaken in support of technical reports on the Project by external consultants SRK (2009), Chlumsky, Armbrust & Meyer, LLC (2009, 2010), Micon (2010) and Pincock, Allen and Holt (2012). These consultants concluded, at the time of their examination, that the data were suitable to support Mineral Resource estimation.

Wood was provided with electronic data files for the density and geotechnical data, and with assay files from Alex Stewart Laboratories, ALS, Acme (now Bureau Veritas) and SGS laboratories. Based on these data, an updated assay database was constructed. This database was merged with the existing assay table and an updated assay table was created to support resource estimation. Updated tables for density and geotechnical information were also constructed.

Wood audited collar survey, downhole survey, assays, density, lithology and redox tables. The data are considered acceptable to support Mineral Resource estimates.

1.9 Metallurgical Testwork

Golden Minerals commissioned Dawson Metallurgical Laboratories, Inc. of Salt Lake City, Utah, to complete testwork on relevant sample composites from Yaxtché.

Initial tests between 2008 and early 2010 on samples of mineralized core from the east, central and west zones were intended to determine the response the samples to whole ore cyanidation, flotation, and a combination of flotation and cyanide leaching of tailings. Testwork was conducted on samples of oxide, mixed supergene and deeper sulphide material, considering both potential open pit and underground mining options.

Subsequent to refining of the mineralization controls and a focus on the underground portion of the deposit, testing from 2010 onwards concentrated on sulphide mineralization.

Metallurgical investigations have evaluated the amenability of composite samples from relevant zones across the deposit to a number of alternative conceptual silver recovery flowsheets including:

- Flotation (concentrate)
- Flotation and cyanidation of flotation tailings (concentrate and doré)
- Flotation and concentrate cyanidation and flotation tailings cyanidation (doré).
- Flotation and concentrate cyanidation (pressure oxidation or POX) and flotation tailings cyanidation (doré)
- Whole ore cyanidation (doré)
- Whole ore cyanidation (post POX) (doré).

This work has concluded in general for sulphide mineralization:

- Whole ore and concentrates are less amenable to direct cyanidation with relatively low silver recoveries below 50%
- The use of POX indicated these relatively cost intensive pre-treatment processing steps were not sufficiently effective to materially improve silver cyanidation recoveries. Direct ore silver recoveries improved up to about 70% and 51% for whole ore and concentrates respectively. This process option still appears to be mineralogically limiting and further mineralogical studies and testwork are required to identify the drivers limiting silver recovery and assess the potential to improve this
- The use of selective flotation resulted in the highest recoveries up to 93%. The results of the batch and locked cycle flotation on the west composite indicated 93% Ag could be recovered to a 6.4 wt% weight pull concentrate with a 10,600 g/t Ag grade. The cleaner test was performed without regrind of the rougher concentrate. Tests indicated that a much higher silver grade could be obtained with regrind. However, the relatively high content of arsenic, antimony and bismuth of the concentrate are a marketing concern

- Flotation recovery variability was indicated in flotation response going from the west (93%) to the central (60%) and east (88%) zones, and lower flotation recoveries were observed. The silver mineralization appears to be different in these zones, but additional mineralogical and testwork needs to be completed to identify the specific silver minerals which have not been differentiated to date as well as understand the main recovery variability drivers. The use of cyanidation of flotation tails in the central and east zone appears to be an option to improve overall silver recovery in those zones to about 80 to 90%.

The currently preferred flowsheet is selective flotation to produce a concentrate followed by cyanidation of tailings to produce doré. Based on the composite samples tested to date, an overall average silver recovery of about 88% could be assumed to be achieved using this hybrid flowsheet. Recovery variability for both flotation and cyanidation is indicated by zone, possibly driven by variations in silver mineralogy and oxidation state, but the use of the hybrid flowsheet generally maintains overall silver recovery in this range. Such assumptions should be confirmed by additional testwork and trade-off studies.

Recovery variability is noted in testwork across the deposit from west to east suggesting a change in silver mineralization that has yet to be identified. There also seems to be a change in mineralized material hardness, possibly associated with lower-grade material, that should be further investigated.

Based on current testwork results, the concentrates that may be produced could contain arsenic, antimony and bismuth impurities, which could potentially result in higher concentrate treatment charges; the potentially elevated levels of arsenic in concentrate may incur a minor penalty charge.

1.10 Mineral Resource Estimation

A hybrid silver model was constructed by first defining the overall geometry of the silver mineralization using implicit modeling software, and then estimating Mineral Resources within the Ag shell using probability assigned constrained kriging (PACK).

A total of 331 drill holes (80,955.0 m) support the resource model. A 150 g/t (ppm) Ag shell was constructed, and 1 m composites inside the shell were used for exploratory data analysis and capping studies. Visual inspection was undertaken of wireframe models constructed for copper, lead, zinc, arsenic, antimony and silver to identify zonation patterns.

Higher alteration intensity codes (visually logged codes that range from 0–3) correlate to higher silver grades, and lower calcium, magnesium and sodium grades. A Quevar alteration index (QAI) was created using calcium, magnesium and sodium assay data to better delineate the geometry of the alteration that can then be used to help define the geometry of the silver mineralization.

Structural trends controlling the silver mineralization were delineated using grade trends, the QAI alteration index, and key lithological units. The trends were recorded using digital terrain model wireframes (DTM), and then imported into Leapfrog Geo software. The composites and the structural trends were then used together to construct a 150 g/t Ag wireframe shell. The grade shell was subsequently imported into Datamine studio for resource estimation.

Visually logged oxide, sulphide and mixed codes in the database (OXIDOS, SULFURO, and MIXTO) were refined by comparing the logged codes to the core photos and codes in adjacent holes. Since the processing method currently being evaluated is a sulphide mill, the mixed was combined with the oxide, and a near-horizontal DTM was constructed to delineate oxide above and sulphide below the DTM.

Density measurements were performed on 1,568 diamond drill core by the on-site exploration geologists using the water displacement method. Density data were recorded in the database, and reviewed spatially and statistically. The spatial review showed that the density samples were representative of the deposit. Density values were estimated into the block model separately for oxide and sulphide using inverse distance squared (ID2) method and an anisotropic flat lying search to reflect the near-horizontal oxide–sulphide boundary.

Grade capping studies were performed for the Yaxtché West and Yaxtché Central domains. Capping was performed on the 1 m composites before further compositing into the 2.5 m composites used for the Mineral Resource estimations. For arsenic and antimony, no capping was applied since many assays exceed the upper limit of the assay method used.

As no obvious changes in direction were noted between Yaxtché West and Yaxtché Central, variograms and grade estimations were performed for both domains combined. Any local variations within the overall trend were accounted for by using dynamic anisotropy during grade estimations which aligns the search ellipse with the structural trends for every block in the model during grade estimation.

The PACK estimation method was selected for its ease to construct multiple models using different silver thresholds. The model was constructed using a 250 g/t Ag threshold:

- The extents of the Ag mineralization were defined using a 150 g/t Ag wireframe shell
- The 150 g/t Ag shell was populated with blocks rotated 30º clockwise around the Z axis. A block size 5.0 m x 2.5 m x 2.5 m (along strike, perpendicular to strike, vertical) was selected

- The 2.5 m composites within the 150 g/t Ag shell were flagged and used to construct an indicator model. If the Ag grade was <250 g/t, the indicator was set to 0, if the Ag grade was ≥250 g/t, the indicator was set to 1
- The indicators were estimated into the150 g/t Ag shell using an inverse distance to the third power (ID3) interpolation method
- The estimated indicator values in the block model were then tagged back into the composites, and only blocks with an estimated indicator ≥0.30 were estimated using only those composites with tagged estimated indicator values ≥0.30
- Silver grades were estimated into the blocks using ordinary kriging (OK), on composites with estimated indicator ≥0.30.

The interpolation was checked using visual inspection of plans, cross- and longitudinal sections. The block model was checked for global bias by comparing the average silver, gold, copper, lead, and zinc (with no cut-off) from the model (OK grades) with means from nearest-neighbour (NN) estimates. In general, an estimate is considered acceptable if the bias is at or below 5%; there were no biases over 5%. Local trends in the grade estimates (swath checks) were performed by plotting the mean silver values from the NN estimate versus the kriged results along strike, along dip-direction and vertical directions. Although the global comparisons agree well, the swath plots illustrate the existence of slight local differences between the NN and kriged model grades, which are considered to be acceptable.

Mineral Resources were classified using a guideline that Indicated Mineral Resources should be quantified within relative ± 15% with 90% confidence on an annual basis, and Measured Mineral Resources should be known within ± 15% with 90% confidence on a quarterly basis. For the Yaxtché model, a drill hole spacing study was performed to determine the nominal drill hole spacing required to classify material as Indicated. The confidence limits, a review of continuity on sections and plans, and an assessment of data quality were all used to determine that a minimum drill hole spacing of 30 by 30 m was required to classify Indicated Mineral Resources. The classification was then smoothed to remove the isolated blocks with a different classification than the surrounding blocks. Material within the 150 g/t Ag shell not classified as Indicated was classified as Inferred, and no Measured is reported.

There are reasonable prospects for eventual economic extraction using the following assumptions: a silver price of $16.62/oz, employment of underground, mechanized, room-and-pillar mining methods, and silver concentrates will be produced and sold to a smelter. Mining costs are estimated to be $55/t at a nominal production of rate 365,000 t/a. Concentrator and general and administrative (G&A) costs are assumed to be $30/t and $20/t respectively. Metallurgical recovery of silver is projected to be 88.5%.

Although silver, copper, lead, zinc, arsenic, and antimony were estimated, the model was optimized to estimate the silver mineralization as it is the only economic contributor and only metal being reported as a Mineral Resource. Gold was estimated to determine if any significant gold credits could be expected, but gold grades were too low to warrant any further studies at this Project stage. Copper, lead, zinc, arsenic, and antimony were estimated to better understand the deposit, and assist with future metallurgical studies.

1.11 Mineral Resource Statement

The Yaxtché underground resource model was constructed by Gordon Seibel, R.M. SME and Principal Geologist with Wood in conjunction with Golden Minerals' personnel.

Mineral Resources are reported in accordance with the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards for Mineral Resources and Mineral Reserves (May 2014; the 2014 CIM Definition Standards) and the CIM Estimation of Mineral Resources and Mineral Reserves Best Practice Guidelines (November 2003; 2003 CIM Best Practice Guidelines).

Mineral Resources are summarized in Table 1-1, and have an effective date of 26 February, 2018.

A number of factors were noted that may affect the Mineral Resource estimate, including: commodity price assumptions; changes in local interpretations of mineralization geometry and continuity of mineralization zones; changes to geotechnical, hydrogeological, and metallurgical recovery assumptions; density and domain assignments; changes to assumed mining method which may change block size and orientation assumptions used in the resource model; input factors used to assess reasonable prospects for eventual economic extraction; assumptions as to social, permitting and environmental conditions; and additional infill or step out drilling or results obtained from extending the exploration decline.

The QP notes that a portion of the 150 g/t Ag wireframe shell occurs in upper portions of the Yaxtché East domain. This material may be amenable to open pit mining methods; however, this would require a separate resource model designed using a lower-cut-off grade, refinement of the oxide-mixed logged codes, and consideration of reasonable prospects of eventual economic extraction using an open pit mining scenario.

Table 1-1: Mineral Resource Table (250 g/t Ag cutoff)

Class	Type	Tonnes (Mt)	Ag Grade (g/t)	Contained Ag Metal (M oz)
Indicated	Sulphide	2.63	487	41.1
	Oxide	0.30	434	4.2
	Total	***2.93***	***482***	***45.3***
Inferred	Sulphide	0.31	417	4.1
	Oxide	0.00	---	0.0
	Total	***0.31***	***417***	***4.1***

1) The independent Qualified Person who prepared the Mineral Resource estimate is Gordon Seibel, a Registered Member of the Society for Mining, Metallurgy and Exploration, RM SME, who is a Principal Geologist with Wood.

2) The effective date of the estimate is February 26, 2018. Mineral Resources are estimated using the CIM Definition Standards for Mineral Resources and Reserves (2014).

3) There are reasonable prospects for eventual economic extraction under assumptions of a silver price of $16.62/oz, employment of underground, mechanized, room-and-pillar mining methods, and that silver concentrates will be produced and sold to a smelter. Mining costs are assumed to be $55/t at a nominal production of rate 365,000 t/a. Concentrator and general and administrative (G&A) costs are assumed to be $30/t and $20/t respectively. Metallurgical recovery for silver is assumed to be 88.5%.

4) Reported Mineral Resources contain no allowances for hanging wall or footwall contact boundary loss and dilution. No mining recovery has been applied.

5) Rounding as required by reporting guidelines may result in apparent differences between tonnes, grade and contained metal content.

1.12 Interpretation and Conclusions

Under the assumptions in this Report, Mineral Resources have been estimated for the Yaxtché deposit, assuming underground mining methods.

1.13 Recommendations

Recommendations have been broken into two phases. The phases can be conducted concurrently, as Phase 2 is independent of Phase 1.

The Phase 1 recommendations are made in relation to database auditability, Mineral Resource estimation, and metallurgical testwork, including:

- Complete annotation of the existing database in support of auditability through documenting which drill holes have had magnetic declination applied, where changes to original logging codes have been made as a result of the completed re-logging and redox re-coding campaigns
- Locate the original total station survey records for the later drill holes, and ensure these are appropriately filed
- Refine the location of the oxide–sulphide boundary

- Construct additional PACK models to better understand sensitivities of the mineralization to changes in commodity prices and changes in cut-off grades if alternative mining methods are selected
- Refine the structural data used to define the silver dynamic anisotropy
- Additional mineralogical and geometallurgical studies and testwork are recommended to understand flotation and cyanidation recovery variability observed between the samples collected for historical testwork represented as west and the central and east zones. This will also help define geometallurgical zoning or domains more precisely relative to silver mineralogy and oxidation state and understand if flotation can be improved to reduce the need to consider cyanidation on the flotation tailings to maintain overall recoveries at acceptable levels
- Evaluate whether geometallurgical domains are required in consultation with geology and resource modelling disciplines, in particular in terms of variations in silver mineralogy and mineralized material hardness in different deposit zones

Phase 1 is estimated at about US$180,000 to US$235,000.

Recommendations proposed in Phase 2 are suggestions for additional data collection and data support for future mining studies, including:

- Extend the existing exploration decline to expose the higher-grade silver mineralization
- Conduct a trial mining program to confirm that the conceptual room-and-pillar mining method is the most appropriate mining method
- Develop appropriate ore-control methods for room-and-pillar mining methods
- Review silver threshold values
- Review metallurgical recovery data to determine if the data are representative of the variability within the deposit
- Study SG values to determine if additional SG estimation domains should be developed

Phase 2 is budgeted at approximately US$500,000 to US$750,000.

2.0 INTRODUCTION

2.1 Introduction

Amec Foster Wheeler E&I Services, Inc., a Wood company (Wood) has prepared a technical report (the Report) for Golden Minerals Company (Golden Minerals) on the El Quevar Project (the Project) located in the Salta Province of Argentina (Figure 2-1).

2.2 Terms of Reference

The Report was prepared to support disclosure of an updated Mineral Resource estimate in the news release dated 28 February 2018, entitled “Golden Minerals Announces New Resource Estimate at El Quevar’s Yaxtché Deposit”.

Mineral Resources and Mineral Reserves are reported in accordance with the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definition Standards for Mineral Resources and Mineral Reserves (May 2014; the 2014 CIM Definition Standards) and the CIM Estimation of Mineral Resources and Mineral Reserves Best Practice Guidelines (November 2003; 2003 CIM Best Practice Guidelines).

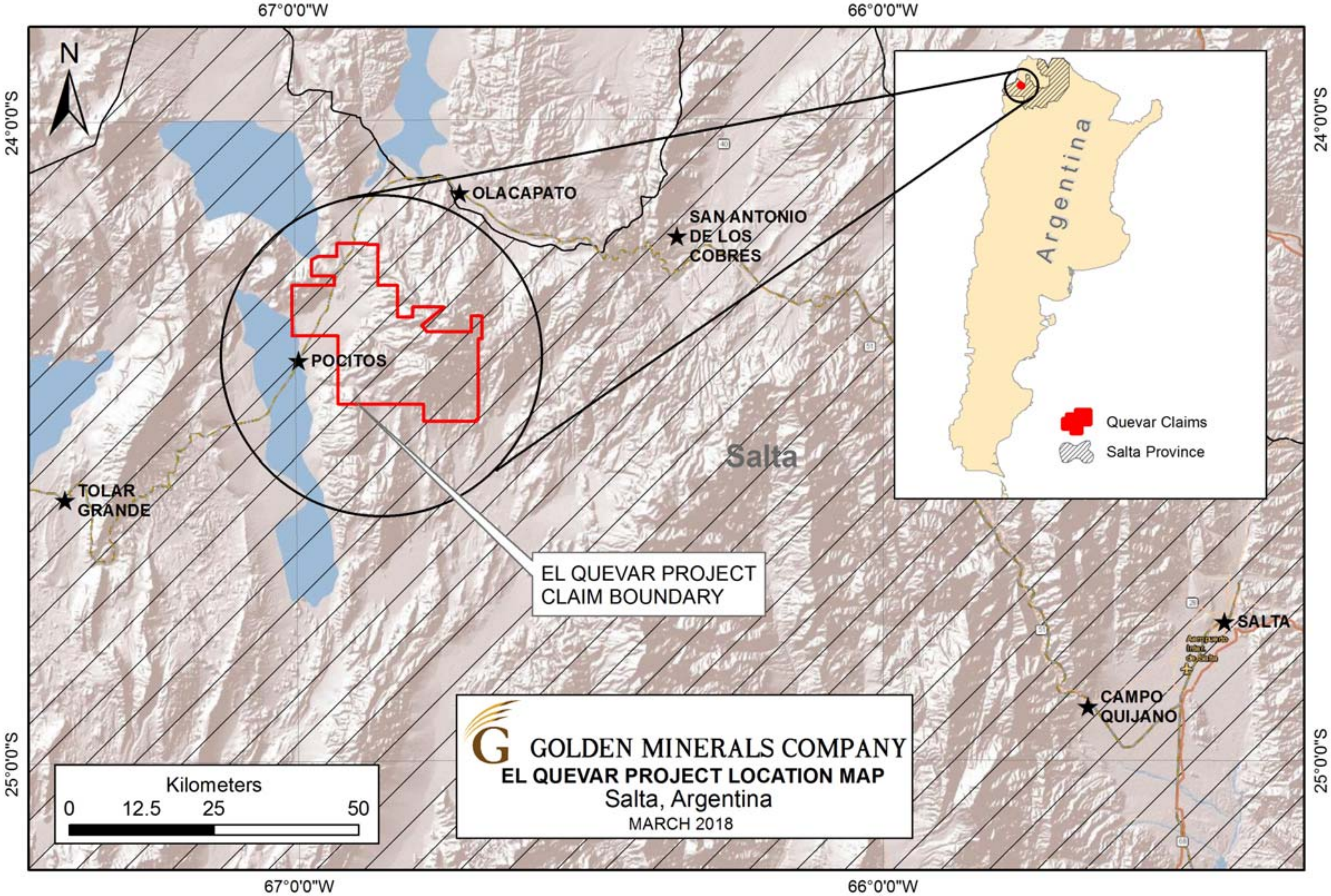
All measurement units used in this Report are metric units and currency is expressed in US dollars (US$), unless stated otherwise. The Argentinean currency is the Argentine peso (AR$). The Report uses Canadian English.

2.3 Qualified Persons

The following persons serve as Qualified Persons (QPs) as defined in NI 43-101:

- Mr Gordon Seibel, RM SME, Principal Geologist, Wood
- Mr William Colquhoun, FSAIMM, Project Manager and Principal Metallurgist, Wood
- Mr Warren M. Rehn, QPMMSA, President, Chief Executive Officer and Director, Golden Minerals.

Figure 2-1: Project Location Plan



Note: Figure courtesy Golden Minerals, 2018.

2.4 Site Visits and Scope of Personal Inspection

Mr. Gordon Seibel visited the El Quevar Project from 20 to 23 March 2018. The site visits included presentations by Golden Minerals' staff, inspection of core and surface outcrops, viewing historic drill platforms, sample cutting and logging facilities, and discussions of geology and mineralization interpretations with Golden Minerals' staff. During his visit, Mr. Seibel checked drill hole locations, inspected drill core, and collected witness samples from the Yaxtché deposit.

Mr Warren Rehn has visited the El Quevar Project more than 10 times since March 2012, the most recent time between 20 to 22 March 2018. During the site visits, Mr Rehn has: visited drill sites while drilling was operational, reviewing drill practices and site layouts; visited the sampling facility and observed core logging and sampling procedures; inspected the adit and underground workings, including inspection of underground sampling and mapping; visited selected outcrops and prospects identified during surface mapping and reconnaissance activities; and inspected drill collar monumenting in the field.

2.5 Effective Dates

The Report has the following effective dates:

- Date of the latest drill hole in the database: 5 March 2012
- Date of the last drilling on the Project: 13 December, 2012
- Date of database close-out for Mineral Resource estimation: 13 Feb 2018
- Date of Mineral Resource estimate: 26 February, 2018
- Date of supply of latest information on mineral tenure: 6 April, 2018.

The overall effective date of the Report is the date of the Mineral Resource estimate, and is 26 February, 2018.

2.6 Information Sources and References

The key information sources for the Report include the reports and documents listed in Section 3.0 (Reliance on Other Experts) and Section 27.0 (References) of this Report, and were used to support the preparation of the Report. Additional information was sought from Golden Minerals and Wood personnel where required.

2.7 Previous Technical Reports

A number of technical reports have been prepared on the Project for Golden Minerals, including:

- Gates, P.A. and Horlacher, C.F., 2012: NI 43-101 Technical Report for Resources Yaxtché Silver Deposit, El Quevar Property, Salta Province, Argentina: technical report prepared by Pincock, Allen and Holt for Golden Minerals Company, effective date 8 June, 2012
- Lewis, W.J., and San Martin, A.J., 2010: NI 43-101 Technical Report and Updated Mineral Resource Estimate for the Yaxtché Silver Deposit El Quevar Project Salta Province, Argentina: report prepared by Micon International for Golden Minerals Company, effective date 10 August, 2010
- Barnard, F., and Sandefur, R.L., 2010: NI 43-101 Technical Report Mineral Resource Estimate Update Yaxtché Silver Deposit El Quevar Project Salta Province, Argentina: report prepared by Chlumsky, Armbrust & Meyer, LLC for Golden Minerals Company, effective date 14 January, 2010
- Barnard, F., and Sandefur, R.L., 2009a: NI 43-101 Technical Report Mineral Resource Estimate Yaxtché Silver Deposit El Quevar Project Salta Province, Argentina: report prepared by Chlumsky, Armbrust & Meyer, LLC for Golden Minerals Company, effective date 12 October, 2009
- Barnard, F., and Sandefur, R.L., 2009b: Mineral Resource Estimate Yaxtché Central Zone Silver Deposit El Quevar Project Salta Province, Argentina: report prepared by Chlumsky, Armbrust & Meyer, LLC for Golden Minerals Company, effective date 15 August, 2009.

A technical report was prepared for Apex Silver Mines (Apex Silver) as follows:

- Mach, L., Hollenbeck, P., Bair, D., Kuestermeyer, A., 2009: NI 43-101 Technical Report on Resources Apex Silver Mines Corporation El Quevar Project Argentina: report prepared by SRK Consulting for Apex Silver, effective date January 31, 2009.

3.0 RELIANCE ON OTHER EXPERTS

3.1 Introduction

The QPs have relied upon the following other expert reports, which provided information regarding mineral rights, surface rights, and royalties.

3.2 Mineral Tenure, Surface Rights, and Royalties

The QPs have not independently reviewed ownership of the Project area and any underlying mineral tenure, surface rights, or royalties. The QPs have fully relied upon, and disclaim responsibility for, information derived from Golden Minerals and legal experts retained by Golden Minerals for this information through the following documents:

- Agustin Saravia Frias, 2018: Legal Opinion on the El Quevar Property, Salta Province, Argentina: report prepared by Saravia Frias Cornejo Abogados for Golden Minerals Company, 6 April, 2018.

This information is used in Section 4 of the Report. The information is also used in support of the Mineral Resource estimate in Section 14.

4.0 PROPERTY DESCRIPTION AND LOCATION

4.1 Introduction

The El Quevar Project is located in northwestern Argentina, approximately 300 km northwest of the provincial capital of Salta, within the San Antonio de los Cobres municipality, Salta Province.

The Project is located close to geographic coordinates 24.3° south and 66.8° west. The UTM coordinates for the Yaxtché zone are approximately 3,418,000 E, 7,307,000 N.

4.2 Property and Title in Argentina

Information in this subsection is based on data in the public domain (Baker Mackenzie, 2013; Parravicini, 2014; Fraser Institute, 2018; and Heredia et al., 2017), and has not been independently verified by Wood or Golden Minerals.

4.2.1 Mineral Tenure

According to Argentine Political State Organization, the mines belong to the Provinces, which grant the exploration and exploitation concession rights to the applicants. However, the Federal Government is entitled to enact the Argentine Mining Code (AMC) which is applicable to the whole country, while the Provinces have the power to regulate the procedural aspects of the National Mining Code through each Provincial Mining Procedure Code (PC) and to organize its local authorities.

In the Province of Salta, the mining rights are granted by a Mining Judge who is the Mining Authority in charge of the procedure.

According to the AMC there are two types of mining rights, exploration and exploitation concessions. Currently, the El Quevar Project consists only of exploitation concessions.

Exploitation Concessions

Exploitation concessions have no time limit provided the holder complies with the requirements of law. Compliance requires an annual canon payment, compliance with a working and investment plan, and the submission of an environmental impact assessment that must be updated every two years. There are different ways of acquiring an exploitation permit:

- By discovering a mine as a consequence of an exploration process
- When a mine is discovered by "chance," that is, without an exploration process

- When an exploitation right has been declared and posted in the register as "vacant" due to a non-compliance with the requirements settled by law.

The measurement unit area for such permits, the tenement (*pertenencia)*, will vary depending on the mineralization to be exploited. Permits over gold, silver, copper, and, generally, hard rock minerals deposits (e.g. vein-style and discrete deposits) are typically 6 ha in extent; however, disseminated mineralization-style deposits may see claim sizes reach a maximum of 100 ha. Exploitation permits can consist of one or more tenements.

The holder of an exploitation permit must meet a series of obligations to maintain the permit in full force and effect. Failure to comply with such obligations could result in revocation of the exploitation permit.

- Canon: must be paid twice a year (June 30 and December 31). Lack of payment results in revocation of the permit, unless the title holder pays the canon plus a 20% fine within 45 days. According to the AMC, the amount to be paid annually is AR$3,200 per unit of disseminated tenement (100 ha) and $320 per unit of tenements of gold, copper or silver (typically 6 ha). A three -ear period free of canon payment is allowed if a mine is discovered
- Legal labour and legal survey: a legal labour to establish the limits of the mine must be performed within 100 days of registration of the mining right. Within 30 days of compliance with the legal labour, a filing requesting a legal survey must be made. The Mining Authority then sets a date and names the professional who will carry out the survey. Once the latter is completed, the concession is registered with the mining cadastre and perfected
- Working and investment plan: a working and investment plan must be created to achieve a minimum expenditure equivalent to 300 times the annual canon paid within five years following the year in which the application of the legal survey is submitted. During each of the first two years, the amount of the investment shall not be less than 20%, while the remaining investment can be freely distributed throughout the remaining three years. An annual investment affidavit should be submitted to the Mining Authority. If the affidavit is not submitted or does not correspond to real investment, the license expires, and the mine is declared vacant, unless the holder amends the mistake or omission within the following 30 days counting from the receipt by the holder of the notification from the Mining Authority. When a mine remains without activity for four years, the Mining Authority may ask the titleholder for the presentation of a "Reactivation Plan." The obligation should be fulfilled within six months, otherwise the mine is declared vacant. The owner should comply with each stage as described in the plan, which cannot exceed five years.

- Environmental impact assessment (EIA): must be filed prior to initiating the field works and must be updated every two years.

4.2.2 Surface Rights

The AMC sets out rules under which surface rights and easements can be granted for a mining operation, and these cover aspects including land occupation, rights of way, access routes, transport routes, rail lines, water usage and any other infrastructure needed for operations.

In general, compensation has to be paid to an affected landowner in proportion to the amount of damage or inconvenience incurred; however, no provisions or regulations have been enacted as to the nature or amount of the compensation payment.

In instances where no agreement can be reached with the landowner, the AMC provides the mining right holder with the right to expropriate the required property.

4.2.3 Water Rights

Typically, Provincial water authorities:

- Issue water usage permits, including usage purpose, amount of water required, how the water is to be delivered to the end-user, and any infrastructure requirements
- Establish a priority system for the permits, based on the type of water consumption
- Govern the duration of issued permits
- Levy usage fees based on the amount of water consumed/used.

Water use rights may be acquired by permit, by concession, and, under laws enacted in some Provinces, through authorization. Revocable permits for water use can be granted for a specific purpose. A grant (*concesión*) is awarded for a time period that is based on the intended use.

4.2.4 Environmental Regulations

Minimum environmental standards are enacted federally, with Provincial governments able to enact supplementary legislation to these minimum standards. The AMC incorporates National Law No. 24.585, key features of which include:

- An environmental impact statement (EIS) must be filed with the relevant regulatory authority
- The AMC has adopted a sectorial approach, in that each mining stage, including prospecting, exploration, exploitation, development, extraction, storage and

beneficiation phases, as well as mine closure, requires separate environmental impact reports (EIRs), each of which are reviewed separately prior to any approval

- If the EIS meets the relevant requirements under National Law No. 24.585, an environmental impact declaration (EID) will be granted; this allows work to commence
- EIDs have a two-year duration or the duration of the activity for which the EID was approved, and a set of conditions and requirements that must be met to keep the EID current

Provinces may also have their own additional requirements relating to EIS preparation.

Provinces also regulate the generation of hazardous waste, water extraction for mining purposes, liquid effluent discharges, and soil protection.

4.2.5 Closure Considerations

Closure must be covered by submission of a new EIR. The document must include details of the proposed environmental rehabilitation, reclamation or adjustment activities, and discuss how post-closure environmental impacts will be avoided. The EIR must include data on post-closure monitoring, but current regulatory requirements do not entail submission of formal closure plans.

4.2.6 Fraser Institute Policy Perception Index

Wood and Golden Minerals have used the Policy Perception Index from the 2017 Fraser Institute Annual Survey of Mining Companies report (the 2017 Fraser Institute survey) as a credible source for the assessment of the overall political risk facing an exploration or mining project in Argentina. Each year, the Fraser Institute sends a questionnaire to selected mining and exploration companies globally. The Fraser Institute survey is an attempt to assess how mineral endowments and public policy factors such as taxation and regulatory uncertainty affect exploration investment.

Wood and Golden Minerals have relied on the 2017 Fraser Institute survey because it is globally regarded as an independent report-card style assessment to governments on how attractive their policies are from the point of view of an exploration manager or mining company and forms a proxy for the assessment by industry of political risk in specific political jurisdictions from the mining industry's perspective.

Of the 91 jurisdictions surveyed in the 2017 Fraser Institute survey, Salta Province ranks 45th for investment attractiveness, 38th for policy perception and 54th for best practices mineral potential.

4.3 Project Ownership

Apex Silver Mines Corporation, a subsidiary of Apex Silver Mines Limited (collectively Apex Silver), acquired the initial interest in the Project in 2004. The Project interest was held by the wholly indirectly owned subsidiary Silex Argentina S.A. (Silex Argentina). Following reorganization under Chapter 11 bankruptcy in 2009, the assets of Apex Silver were transferred to Golden Minerals Company. As part of that transaction, Silex Argentina became a wholly indirectly-owned subsidiary of Golden Minerals.

4.4 Mineral Tenure

The El Quevar Project is consists of 31 exploitation concessions (approx. 57,000 ha). Exploitation concessions are subject to an annual canon payment fee (refer to Section 4.2.1).

To maintain all of the El Quevar concessions, Golden Minerals paid canon payment fees to the Argentine government of approximately US$110,000 in 2016 and in 2017. In 2018 the company expects to pay approximately US$90,000.

The concession holdings are summarized in Table 4-1 and shown in Figure 4-1. Figure 4-2 shows the footprint of the Yaxtché Mineral Resource estimate, with respect to the claim outlines. The figure also shows claims for which a private royalty obligation exists.

4.5 Surface Rights

Surface rights at the El Quevar Project are owned by the province of Salta, and as a result there are no agreements required for access. In addition, the El Quevar area has no existing private properties or other infrastructure that would limit exploration activities. Although Golden Minerals has unrestricted access to its facilities, the company has been granted easements from the Province of Salta to further protect access rights. These easements are summarized in Table 4-2.

4.6 Water Rights

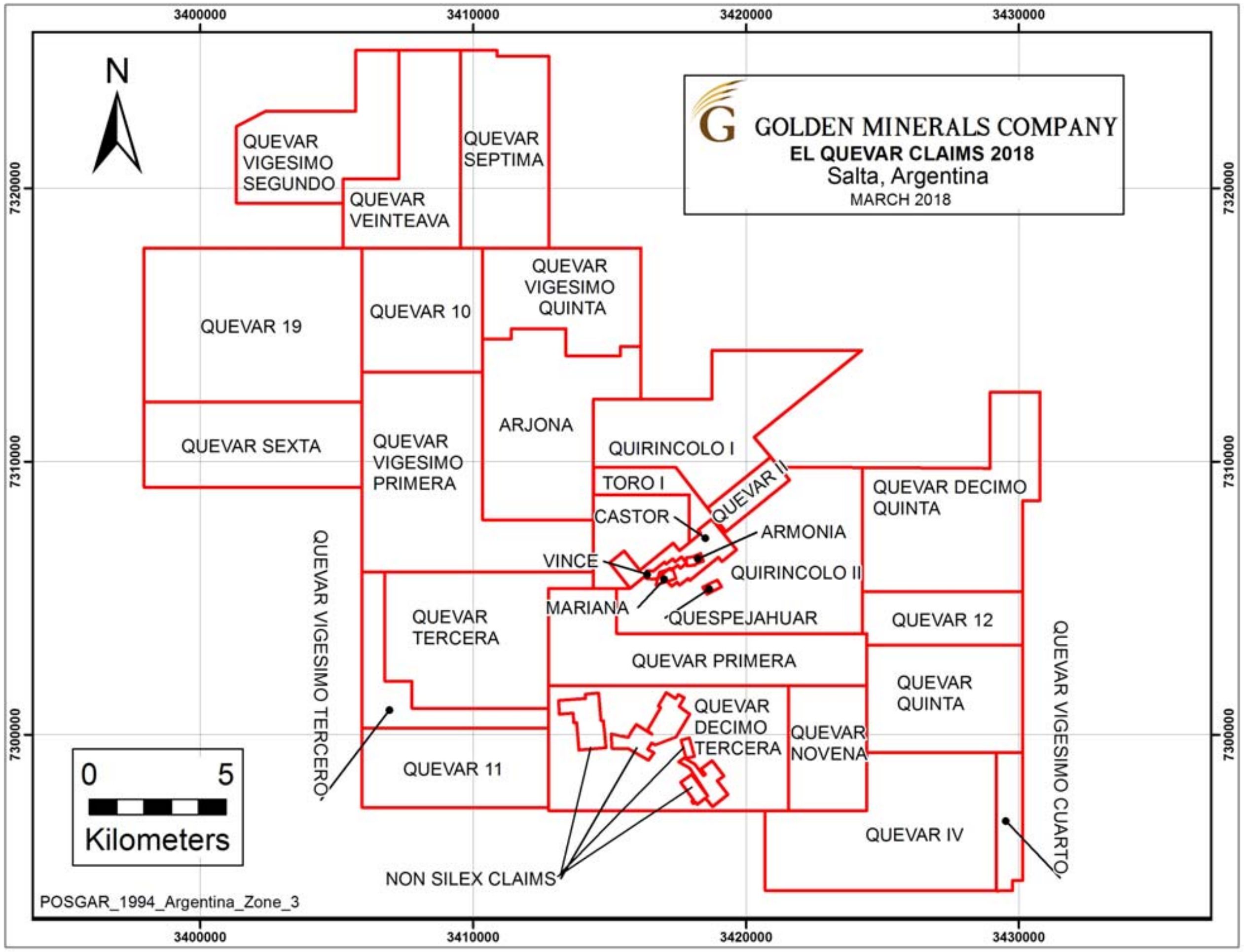
Silex Argentina has applied for both surface and underground water concessions which are currently pending. These concessions currently provide water for the camp and for other exploration activities and can be re-permitted as needed for higher capacity.

In 2017, the amount to be paid was AR$1.52/$m^3$. The amount for 2018 period has not been yet fixed.

Table 4-1: Mineral Tenure Table

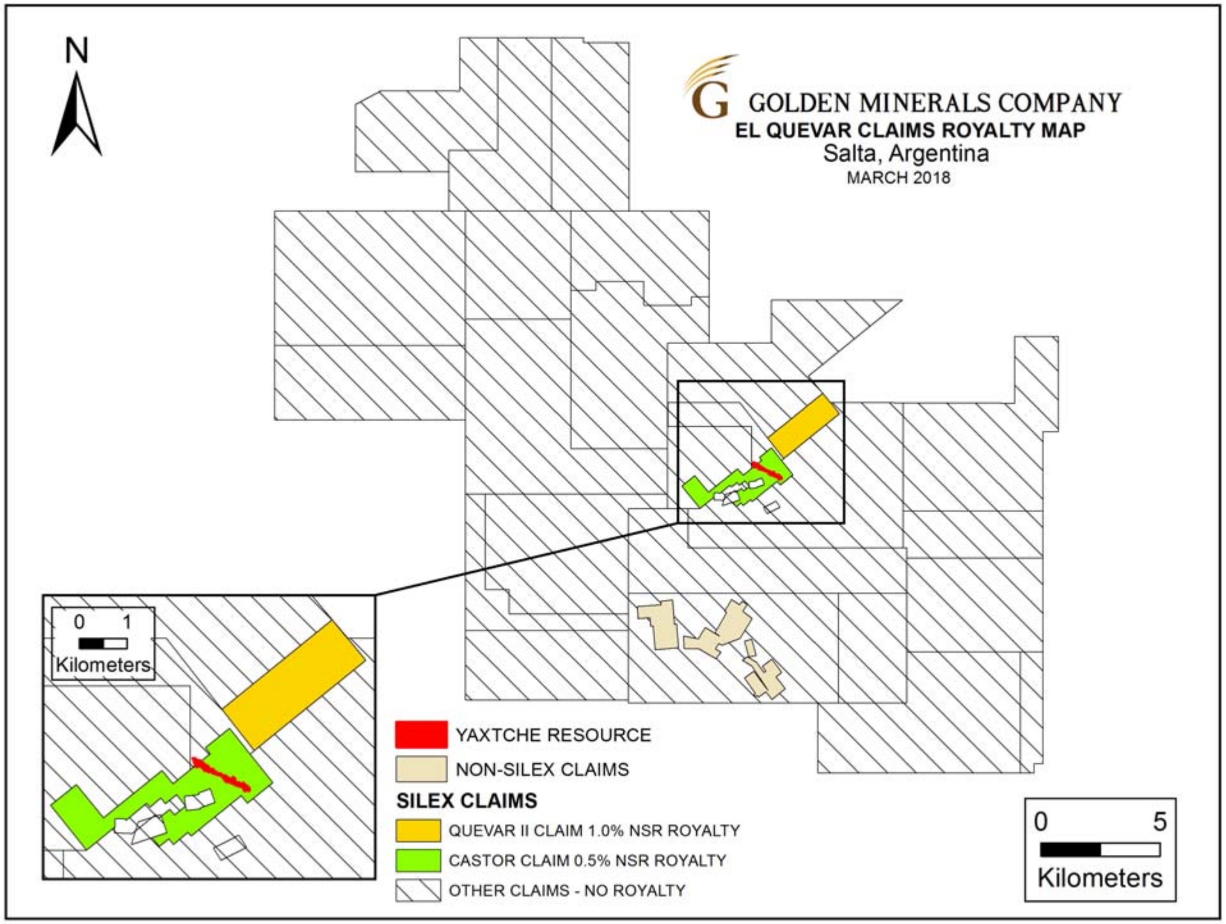
Concession Name	File #	Hectares
Arjona II	18080	3,000.00
Armonia	1542	17.91
Castor	3902	384.10
Mariana	15190	26.31
Quespejahuar	12222	18.00
Quevar 10	20219	1,997.80
Quevar 11	20240	1,988.03
Quevar 12	20360	1,146.48
Quevar 19	20706	3,500.00
Quevar Decima Quinta	20445	3,254.66
Quevar Decimo Tercera	20501	3,354.93
Quevar II	17114	330.04
Quevar IV	19558	3,500.00
Quevar Novena	20215	1,312.99
Quevar Primera	19534	2,626.07
Quevar Quinta	19617	2,242.73
Quevar Séptima	20319	2,301.05
Quevar Sexta	19992	2,493.53
Quevar Tercera	19557	2,999.76
Quevar Veinteava	20988	21,51.58
Quevar Vigesimo Cuarto	21044	468.00
Quevar Vigesimo Primera	20997	3,499.99
Quevar Vigesimo Quinto	21054	1,993.71
Quevar Vigesimo Segundo	21042	2,143.63
Quevar Vigesimo Sexta	22087	992.55
Quevar Vigesimo Tercero	21043	995.63
Quevar Vigésimo Séotima	22403	497.84
Quirincolo I	18036	3,500.00
Quirincolo II	18037	3,500.00
Toro I	18332	436.61
Vince	1578	44.73
		56,718.66

Figure 4-1: Mineral Tenure Layout Plan



Note: Figure courtesy Golden Minerals, 2018.

Figure 4-2: Mineral Resource Outline in Relation to Claim Boundaries



Note: Figure courtesy Golden Minerals, 2018.

Table 4-2: Granted Easements

Easement Number	Type of Easement
19.137	Camp
21.003	Road
21.004	Waste rock facility
21.005	Water
21.006	Electric
21.009	Services road
20.666	Plant

4.7 Royalties and Encumbrances

Golden Minerals is required to pay a 1% net smelter return (NSR) royalty on the value of all minerals extracted from the El Quevar II concession and a 1% NSR royalty on one-half of the minerals extracted from the Castor concession to the third party from whom the concessions were acquired from. Golden Minerals can purchase one half of the combined royalty interests for US$1 million during the first two years of production.

The Yaxtché deposit is located primarily on the Castor concession. Golden Minerals may also be required to pay a 3% royalty to the Salta Province based on the mine mouth value of minerals extracted from any of the concessions unless new legislation is enacted by the Argentine Federal Congress that will allow Salta Province to levy up to 3% royalty of the gross revenue accrued in a year.

4.8 Permitting Considerations

Silex Argentina maintains the required environmental permits. These permits must be renewed every two years. New permits will be obtained as needed for additional exploration disturbance or for further development work. Typically, such permits take a maximum of 90 days to be approved once submitted

All previous work, including the decline, mine site installations, exploration drilling and trenching, road construction and camp installation, was completed under fully-authorized permits.

Silex Argentina is registered with the Registro Nacional de Armas (National Registry of Weapons) and is allowed to store explosives at the El Quevar Project.

A program of surface water sampling and reporting is in place as a condition for the ongoing environmental permits.

4.9 Environmental Considerations

There are artisanal prospecting pits and minor workings within the Project area. There are more small-scale workings at the El Queva (Jaguar or Mani) mine, which operated from 1968 to 1973. There is an expectation that there will be environmental liabilities associated with the artisanal and small-scale mining activity.

Golden Minerals has initiated reclamation activities on some of the historical disturbances including reclaiming and recontouring all pre-2012 trenches, drill stations, and non-essential drill access roads.

Sulphide-bearing muck extracted from the decline was placed in lined and covered trenches, now fully recontoured, according to an approved reclamation plan.

Perlite quarries (see Section 6) are inactive. Golden Minerals will be responsible for reclamation of these quarries if any is required. To date, there has been no estimate or determination as to whether a liability exists.

4.10 Social License Considerations

The Project lies completely within the Andean Natural Reserve Zone (La Reserva Natural Los Andes) which is classified as a multi-use area (Categoría de Manejo de Uso Múltiple VIII). This classification allows for production/extraction activities including exploration and mining. The reserve’s main purpose is to provide vicuña habitat.

4.11 Comments on Section 4

The QP notes:

- Legal opinion provided supports that Golden Minerals currently holds an indirect 100% interest in the El Quevar property through its subsidiary Silex Argentina
- Legal opinion provided supports that the mineral tenures held are valid and sufficient to support declaration of Mineral Resources
- The AMC sets out rules under which surface rights and easements can be granted for a mining operation. In instances where no agreement can be reached with the landowner, the AMC provides the mining right holder with the right to expropriate the required property
- Water use rights may be acquired by permit, by concession, and, under laws enacted in some Provinces, through authorization
- Golden Minerals is required to pay a 1% NSR royalty on the value of all minerals extracted from the El Quevar II concession and a 1% NSR royalty on one-half of the minerals extracted from the Castor concession. Golden Minerals can purchase

one half of the combined royalty interests for US$1 million during the first two years of production

- Golden Minerals may also be required to pay a 3% royalty to the Salta Province based on the mine mouth value of minerals extracted from any of the concessions unless new legislation is enacted by the Argentine Federal Congress that will allow Salta Province to levy up to 3% royalty of the gross revenue accrued in a year
- Silex Argentina maintains the required environmental permits. All previous work was completed under fully-authorized permits

The QP was advised by Golden Minerals that Golden Minerals is not aware of any significant environmental, social or permitting issues that would prevent future exploitation of the Yaxtché deposit other than as discussed in this Report.

5.0 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE, AND PHYSIOGRAPHY

5.1 Accessibility

The El Quevar property is accessed from Salta (capital of Salta Province) by following National Road 51 (NR51) to the turnoff to Provincial Road 27 (PR27) for approximately 226 km. From Salta to San Antonio de los Cobres, NR51 consists of either a paved or well-maintained gravel surface. Beyond San Antonio de los Cobres, NR51 is a well-maintained gravel road to the junction with PR27. From the intersection, the El Quevar property is accessed by driving south for approximately 30 km to the junction with the access road and then east, with the camp currently located approximately 10 km from the junction. Driving time from Salta to the Project camp is approximately four to five hours.

Salta is accessed by a number of highways and roads which connect it with the rest of Argentina, as well as with Chile and Bolivia. Salta has a major airport with daily flights to Buenos Aires, as well as a number of other Argentinean and Bolivian cities.

A narrow-gauge railway which connects Salta with the city of Antofagasta in Chile passes within 5 km of the Project area. This government-owned railway is currently active only as a tourist train near San Antonio de Los Cobres and does not now connect with Salta or Antofagasta.

5.2 Climate

The climate is characteristic of high mountain environments. The weather is extremely dry and ranges from polar conditions on the higher mountain peaks to arid steppe environments at the valley floors. Most precipitation falls between November and March as heavy rains, hail and snow. Total precipitation is variable and can range from 50mm in dry years to 200mm during wetter years. Temperatures during the winter months vary from 10ºC day during the day to -25ºC at night. During the summer months, temperatures in the daytime can reach 25ºC falling to -5º C at night. Moderate to high winds are characteristic of the winter months.

It is expected that any future underground mining operations will be conducted year-round. Exploration activities can be temporarily curtailed by rainfall or snow during the period from November to March.

5.3 Local Resources and Infrastructure

Salta (pop. 619,000) is the major regional supply centre and has all major services.

The closest settlement, in a sparsely-populated area, is the town of Pocitos (pop. circa 80), 20 km southwest of the Project. The next closest settlement is San Antonio de los

Cobres (pop. 4,000), the local departmental government seat, about 90 km to the southeast of El Quevar, on the road to Salta. Minor services are available.

The 210,000 m^3/d high-pressure Gasoducto Minero natural gas pipeline passes through the Project area, about 5 km west of the exploration camp. Gas is available for mining projects in Salta Province.

Grid electricity is potentially available from a 354 kV high-voltage power line, owned by Termo Andes, which passes 30 km north of Yaxtché (no spare capacity at present). There is currently no external electric power to El Quevar. Power to the exploration camp is supplied by two 275 kVA diesel generators.

Water for camp use is pumped from a 100 m deep well that is pumped at a rate of about 10 m^3/d, but which can be expanded to about 50 m^3/d by paying the required usage fees. Additional water resources sufficient for mineral processing use can be obtained from the same groundwater source.

The exploration camp, rated for 96 persons, is situated on the El Quevar III concession. The camp consists of accommodations, offices, and core splitting, logging, and equipment maintenance facilities.

Manpower can be sourced for exploration activities in the Province.

5.4 Physiography

The Project is located in the altiplano (puna) region of the Puna Block of the central Andes, on the western slope of a volcanic edifice. The volcanic massif has two peaks, Nevado de Quevar (6,130 m) and Cerro El Azufre (5,840 m). Drainage from the edifice slopes has formed steep canyons, with the water draining to an extensive complex of alluvial fans that grade into three salt flats, Salar de Pocitos (elevation 3,700 m) to the southwest, Rincon (3,800 m) to the west, and Cauchari (3,900 m) to the northwest.

Most of the mineralized areas are located between 4,500 and 5,100 m above sea level, with the Yaxtché zone surface exposures located between 4,800 and 4,900 m. The exploration camp is located west of the deposit area where a canyon opens up into a large alluvial fan at an elevation of 4,000 m.

Vegetation is characteristic of steppe climates adapted to harsh conditions, consisting of clumps of spiny grass known as coirón or ichu with no native trees or large shrubs. Most of the Project area consists of barren outcrop, talus, alluvium and landslide blocks.

Wildlife is rare due to the altitude and aridity. Native wildlife observed has included tinamou (birds), ñandu (rhea), fox, vicuña (camelid), guanaco (camelid), and mountain lion. Domesticated livestock includes burros, sheep, cattle, llamas and alpacas.

5.5 Comments on Section 5

Any future underground mining operations are expected to be operated year-round.

There is sufficient suitable land available within the mineral tenure held by Golden Minerals for infrastructure such as tailings disposal, mine waste disposal, and process plant and related mine facilities.

A review of the existing power and water sources, manpower availability, and transport options indicates that there are reasonable expectations that sufficient labor and infrastructure will be available to support exploration activities and any future mine development.

6.0 HISTORY

The Project history is summarized in Table 6-1.

Small scale mining and prospecting on the El Quevar property is reported to have occurred intermittently since the 1800s. After 1930, with improved access into the region, mining and prospecting activity increased but only at the local level.

Production is not well documented. Sillitoe (1975) notes that the "*El Queva mine has produced a little over 3,000 tons of ore during its intermittent operating life from 1968 to early 1973, with a maximum output of 1,270 tons in 1970. Ore grades are difficult to estimate but hand-cobbed material seems to have averaged about 8% Pb and 0.2% Ag*". The El Queva mine has also been referred to as the Jaguar Mine, and the mine area is now part of the Mani zone (Chlumsky, Armbrust & Meyer, 2009).

There is no known commercial production of base metals, gold, or silver from the Project. Minor production of perlite has occurred; however, there are no official production figures.

Table 6-1: Project History

Year	Operator	Work Completed
1971 to 1974	Government-sponsored Plan NOA-1	Completed geological field work and prospecting.
1970s	Fabricaciones Militares	Completed 3 or 4 holes, probably in Quevar North. No records of results have been located.
1970s	BHP-Utah Minerals International	Completed 3 holes in the Mani-Copan area just south of Yaxtché. No records of results have been located.
1990s	Industrias Peñoles	Surface sampling in Quevar South. No records of results have been located.
1997	Minera Hochschild	Completed 6 reverse circulation and diamond core holes in the Mani and Yaxtché West area, as well as trenching across the Mani structure.
1999	Mansfield Minerals	Surface and pit samples at Yaxtché
2004	Apex Silver Mines Corporation/ Apex Silver Mines Limited (Apex Silver)	Acquired property interest
2004–2006	Apex Silver	Mapped in the Quevar South area at 1:5,000 and 1:10,000 scale; completed reconnaissance outcrop sampling using channel, panel and select chip samples.
2006	Apex Silver	Joint venture signed with Hochschild Mining plc. (Hochschild); formed Minera El Quevar, 65% owned by Apex Silver and 35% by Hochschild.
2006	Apex Silver	Completed a core drilling program of 19 core holes (2,377 m) in the Quevar South area, targeting the Mani, Copán and Yaxtché structural trends.
2007	Apex Silver	19 core holes (2,482 m) completed on the Yaxtché structural trend; Mani zone, and Quevar North. Also excavated 16 trenches totaling 3,300 m; 4 trenches at Quevar North and 12 in Quevar South. Submitted 24 samples from six drill holes for petrographic and electron microscopy examination.
December 2007 to February 2008	Apex Silver	Ground IP/resistivity geophysical survey with 3-D pole/dipole over El Quevar South. Line separation was at 200 and 400 m with markers at 50 m intervals along lines.
2008	Apex Silver	43 core holes (10,651 m)
2009	Apex Silver/Golden Minerals	Following reorganization under Chapter 11 bankruptcy in 2009, Apex Silver becomes Golden Minerals.
2009	Apex Silver/Golden Minerals	114 core holes (23,111 m) completed in the Castor and Quevar II areas in Quevar South. Initial and first update mineral resource estimates.
2009	Golden Minerals	13 core holes (1,414 m) Viejo Campo area. This area is not part of the current property holdings.
2010	Golden Minerals	Acquired Hochschild interest; consolidated ownership of the Minera El Quevar joint venture.
2010	Golden Minerals	67 core holes (20,302 m) completed at Yaxtché West, Yaxtché East, Yaxtché Extension, Mani Sub and Sharon. The Sharon area drilling is outside of current property holdings (1,017 m in 6 holes). Mineral resource estimate update.
2011–2012	Golden Minerals	Construction of adit and decline to access the eastern part of the Yaxtché zone and to investigate the continuity of the mineralization by drifting, channel sampling and bulk sampling of development rounds. 125 core holes (38,967 m) completed at Yaxtché West, Yaxtché Central,

		Mani Sub and Carmen; some holes drilled for condemnation purposes.
2012	Golden Minerals	Resource estimate update
2012–2013	Golden Minerals	16 core holes (2433 m) drilled in exploration areas in Quevar South (Carla, Andrea, Puntana, Argentina) and Quevar North (Sharon, Amanda, Luisa, Julia) areas. Drilling in the Quevar North areas is outside of the current property holdings (7 drill holes, 895 m)

7.0 GEOLOGICAL SETTING AND MINERALIZATION

7.1 Regional Geology

The El Quevar Project is located along the southern margin of the Altiplano-Puna volcanic complex of the Andean Central Volcanic Zone (Figure 7-1). The complex was formed in late Miocene time as a result of intense and prolonged ignimbrite volcanism resulting in a major silicic volcanic province covering an area of ~50,000 km^2. A dominant feature of the complex are several large nested caldera complexes from which major, regionally distributed ignimbrite sheets were sourced (de Silva, 1989).

The Project is located within the Quevar volcanic complex (QVC) which is interpreted as one of the major ignimbrite sources on the Altiplano-Puna volcanic complex (de Silva et al., 2006). The main volcanic events within the El Quevar complex have been dated at 19–17 Ma, 13–12 Ma, 10 Ma, 7–6 Ma and 1–0.5 Ma.

7.2 Project Geology

7.2.1 Lithologies

The QVC sits within a NE trending belt of Quaternary stratovolcanoes and associated domes (refer to Figure 7-1). Locally, the volcanic stratigraphy includes extensive pyroclastic flows (lithic and crystal-lithic tuffs and ignimbrites), rhyolite flows, andesitic flows, and resurgent domes of dacitic composition. Doming is associated with multiple intrusions and mineralizing events.

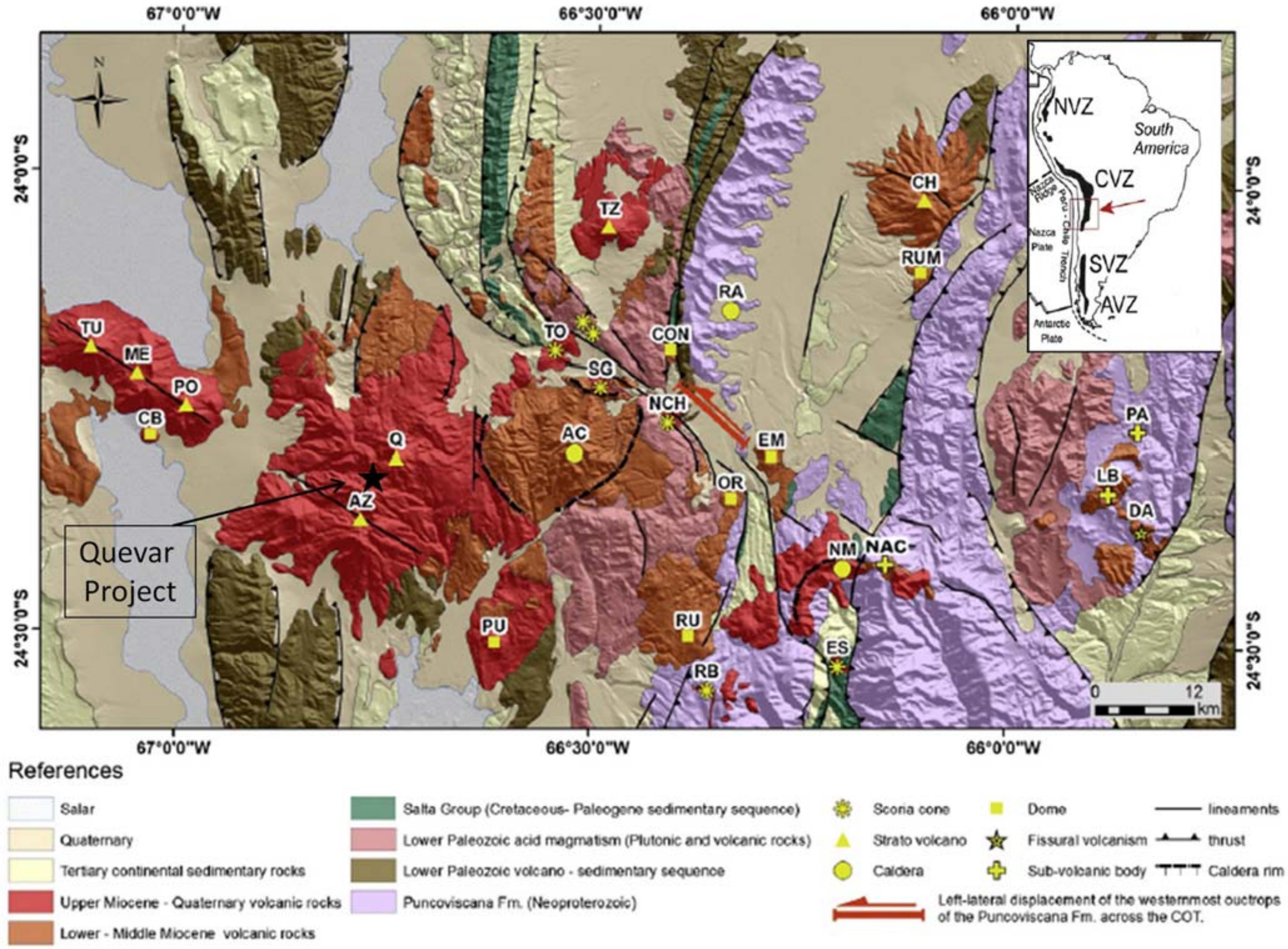
Locally, the volcanic rocks interfinger with Miocene to Pliocene age red sandstone that is correlative to the Pastos Grandes Group. Basement in the area is an Ordovician–Silurian marine sedimentary clastic suite consisting of shales and sandstones that have been greenschist metamorphosed to metapelites.

Late Pleistocene glaciation and fluvial and mass-wasting processes have eroded the complex, creating erosional windows, landslides and extensive alluvial fans.

7.2.2 Structure

The Quevar volcanic complex is structurally bounded by regional orogen-oblique 125° striking structures and orogen-parallel 025° striking lineaments characteristic of the structural evolution of the Puna Plateau (refer to Figure 7-1). Most notably, the orogen-oblique Calama-Olacapato-El Toro (COT) fault system bounds the complex to the northeast. The COT is considered one of the main northwest–southeast tectonic structures of the Puna Plateau, and is an active fault zone associated with Miocene to Recent magmatic centres (Norini et al., 2013).

Figure 7-1: Regional Geology Plan



Note: Figure courtesy Golden Minerals, 2018. Figure modified from Norini et al., 2013. Stratovolcanoes in the immediate project area: Q = Quevar; AZ = El Azufre

7.2.3 Alteration

The Project sits within one of three large erosional windows that have exposed expansive zones of steam-heated alteration (Figure 7-2). Such lithocaps have been widely reported within the high sulphidation epithermal environment above porphyry copper deposits. Mineralization was discovered at Yaxtché within a low-lying outcrop of leached and silicified dacite that is exposed at the base of the Quevar South alteration halo. With the exception of the surficial steam-heated alteration and a few scattered silicified outcrops, the bulk of information relating to hydrothermal alteration is known from drill core (see Section 7.3).

7.2.4 Mineralization

Silver is the element of economic significance at El Quevar and anomalous concentrations of copper, lead, zinc, and lesser gold occur locally. The nature of mineralization is consistent with that of a high to intermediate sulphidation state (see Section 8).

Mineralization occurs in various styles across the Project area from mineralized veins (e.g. Mani prospect) to disseminated and replacement style mineralization at Yaxtché.

Sillitoe (1975) noted the native sulphur deposits near the summits of Queva and El Azufre together with several small manganese deposits occurred around the periphery of the volcanic complex. The spatial and temporal relationships of the silver, sulphur, and manganese mineralization were used by Sillitoe to reconstruct an idealized paleo-hydrothermal system forming above an inferred porphyry copper deposit.

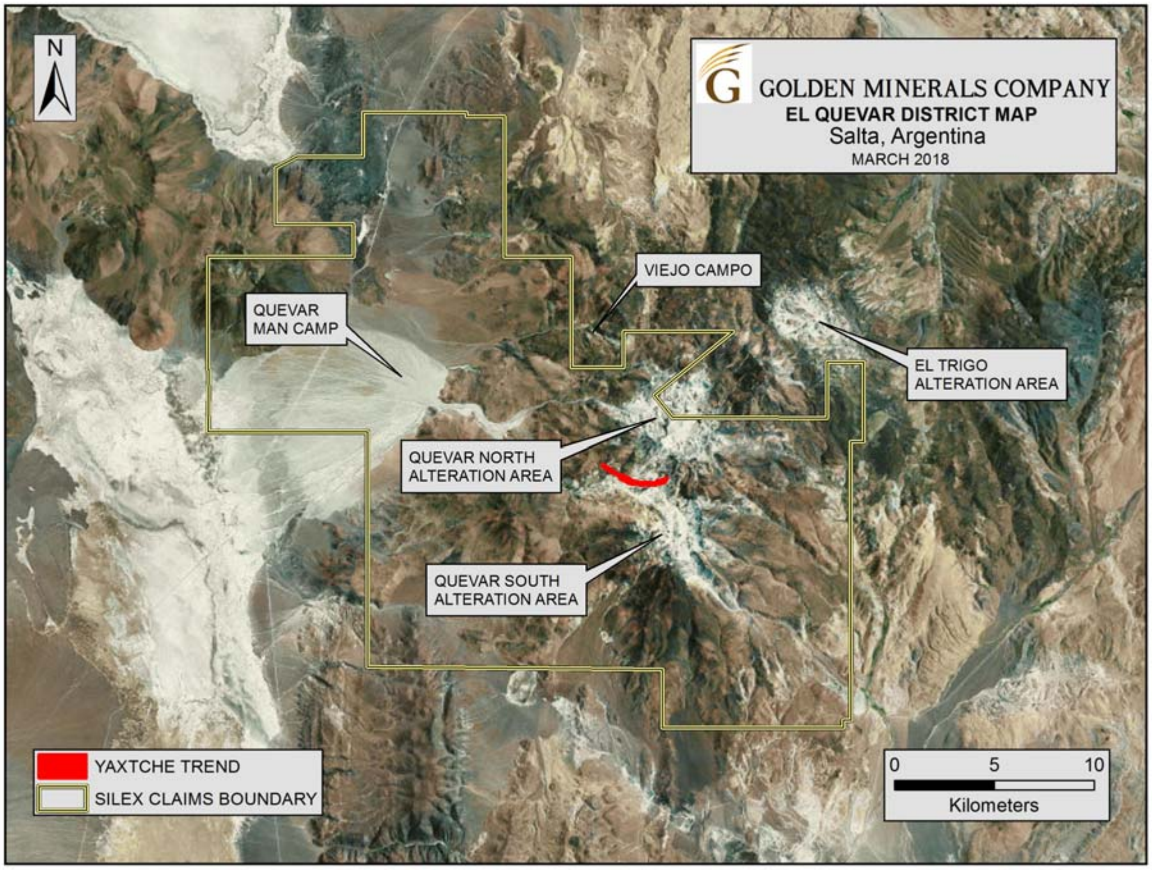
7.3 Deposit Description

7.3.1 Lithologies

The major lithologies within the Yaxtché deposit are depicted and summarized in Figure 7-3.

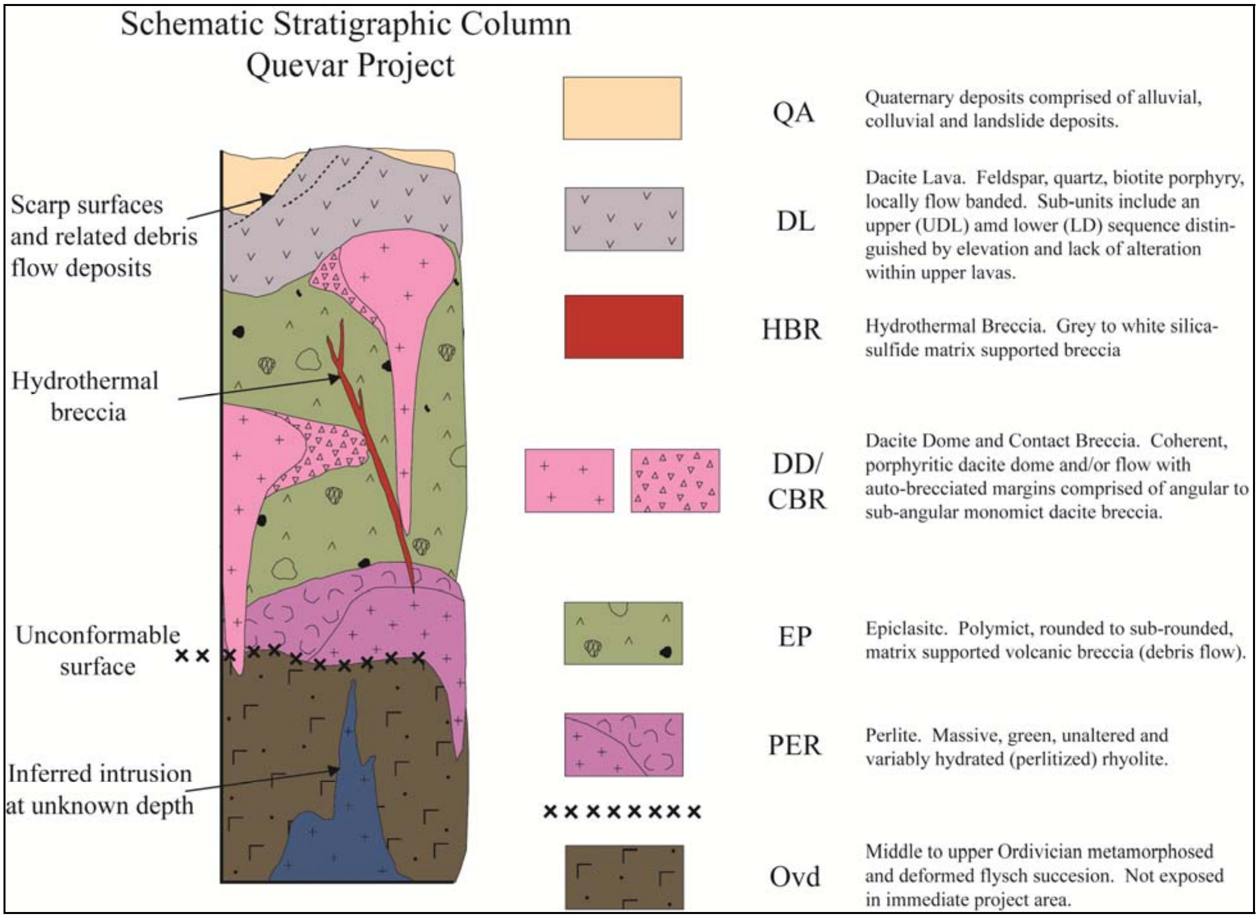
Although poorly exposed on surface, the most abundant rock type encountered in Yaxtché drill holes is the epiclastic unit (EP). This unit is characterized as a matrix supported volcanic breccia with large (few centimetres to tens of centimetres), rounded to sub-rounded, polymictic volcanic clasts within a fine-grained matrix. The EP unit is interpreted to have formed as a debris flow.

Figure 7-2: Yaxtché Deposit Outline Relative to Large Zones of Exposed Hydrothermal Alteration



Note: Image courtesy Golden Minerals, 2018.

Figure 7-3: Schematic Stratigraphic Column

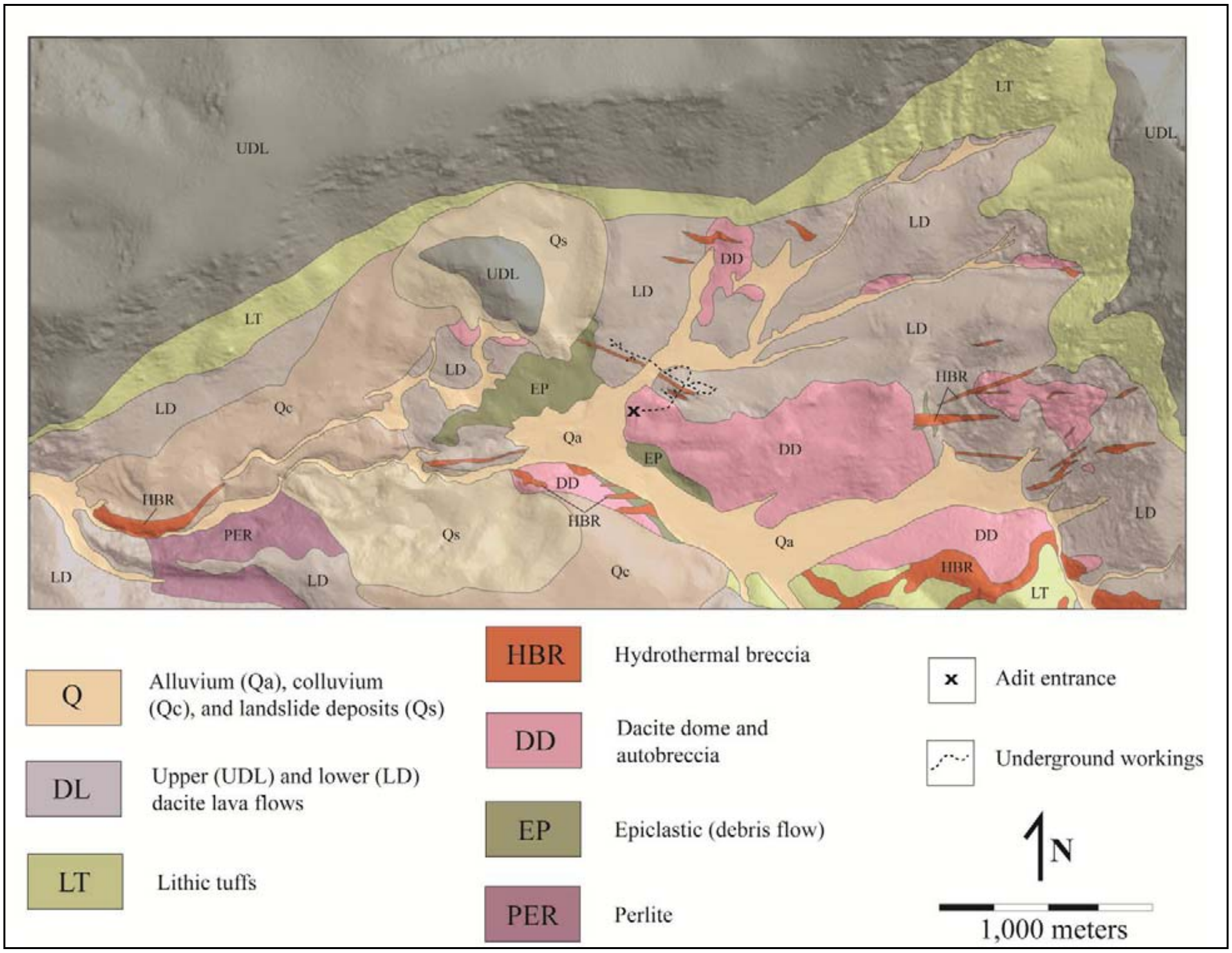


Note: Figure courtesy Golden Minerals, 2018.

A complex of porphyritic dacite domes and associated breccias have intruded within and atop the epiclastic unit. The coherent interiors of these domes (DD) are characterized by quartz-feldspars-biotite phenocrysts set within a fine-grained matrix of similar composition. Spatially associated with the dacite domes is a monomict, angular, clast- to matrix-supported volcanic breccia (CBR) that is interpreted to be the autobrecciated margin of the DD unit.

Stratigraphically atop the EP unit are a series of dacite–andesite flows (DL) that cap the volcanic succession and form prominent ridges in the Quevar South area (Figure 7-4). This volcanic succession is characterized by feldspar-phyric porphyritic lavas that represent a period of large-scale effusive volcanism in the area.

Figure 7-4: Quevar South Project Geology



Note: Figure courtesy Golden Minerals, 2018.

The lavas have been sub-classified into an upper (UDL) and lower (LD) dacite flow succession. The distinction between these units appears to be based on their stratigraphic position (i.e. elevation) and/or the degree of hydrothermal alteration recognized. The uppermost dacite lavas are unaffected by hydrothermal alteration and are thus interpreted to be post-mineral flows.

7.3.2 Alteration

Hydrothermal alteration at the Project is summarized and updated from Corbett (2012). Zoned advanced argillic alteration at El Quevar is typical of that which might be expected to occur in association with high-sulphidation epithermal gold deposits.

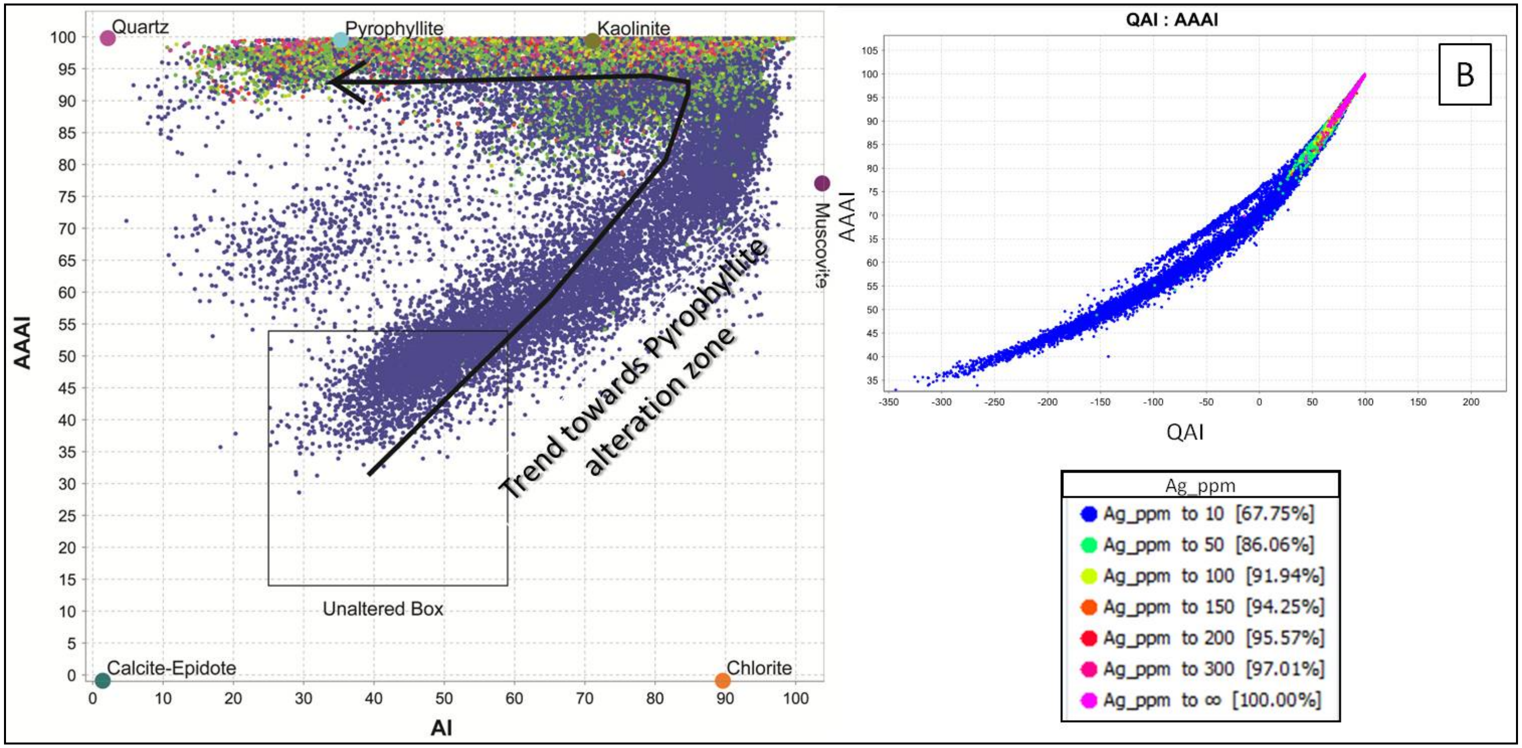
Elements of the zoned advanced argillic alteration from the centre outwards are classed as:

- Vuggy silica: forms as hot extremely acidic (pH 1–2) fluid leaches feldspars to provide rectangular pseudomorphous vugs after feldspar, and participates in textural destruction to provide rounded vugs. The textural destruction caused by acidic alteration forms zones of enhanced permeability through which the later mineralized fluids ascended
- Pervasive silica: displays similarities to that developed in the core zones of many structurally-controlled zones of advanced argillic alteration, and occurs outboard of the leached vuggy silica domains
- Silica–alunite: develops in a marginal setting to the vuggy silica core as the causative hydrothermal fluid becomes progressively cooled and neutralized by reaction with wall rocks and so deposits alteration mineralogy typical of less acidic conditions of formation
- Kaolinite–dickite: forms marginal to the silica–alunite alteration by reaction with wall rocks of the progressively cooled and neutralized hydrothermal fluid
- Neutral argillic: characterized by silica–smectite–illite–ankerite ± pyrite is common outside the advanced argillic alteration and is interpreted to have developed in response to polyphasal dome emplacement. The smectite-rich alteration is apparent as swelling clays. The neutral argillic alteration is overprinted by the advanced argillic alteration
- Steam-heated: is apparent in the uppermost portions of El Quevar as typical powdery alunite–cristobalite–kaolin developed by reaction with wall rocks of acidic waters derived from the oxidation of rising H_2S above the water table. It therefore occurs as ‘blankets’ overlying many high-sulphidation epithermal systems
- Propylitic: occurs as the outermost zone of alteration at El Quevar and is characterized by a chlorite–epidote ± pyrite mineral assemblage yielding a distinctive green colour to the affected rocks.

An attempt to quantify the effects of hydrothermal alteration has resulted in the development of the Quevar alteration index (QAI). The QAI tracks the changes of the mobile major elements calcium, magnesium and sodium in response to acid-leaching processes associated with hydrothermal alteration as described above.

The QAI follows the advanced argillic alteration index (AAAI) of Williams and Davidson (2004) but is specific to the El Quevar Project and the available chemical analyses. The relationship between the AAAI and the QAI is shown in Figure 7-5, together with the correlation of silver grade to alteration intensity.

Figure 7-5: Quevar Alteration Index



Note: Figure courtesy Golden Minerals, 2018.

The QAI is defined as

$$QAI = \frac{100(SUM:\ LA\ Ca\% + LA\ Mg\% + LA\ Na\%) - (SUM:\ Ca\% + Mg\% + Na\%)}{(SUM:\ LA\ Ca\% + LA\ Mg\% + LA\ Na\%)}$$

where LA stands for the average least altered composition for Quevar host rocks.

The QAI has proven to be an effective tool for determining hydrothermal fluid pathways that contain silver mineralization. Zones of leaching and feldspar destruction defined by the QAI are typically much broader than areas of silver mineralization, and thus may be useful as an exploration tool outside of the Yaxtché deposit.

7.3.3 Mineralization

Mineralization at Yaxtché consists of fine-grained black sulphides and sulphosalts that are difficult to identify in hand specimen. The mineralization occurs variously as disseminations, open-space filling, and in massive veinlets or clots. The identified mineralogy is consistent with that expected within a high to intermediate sulphidation epithermal deposit (refer to discussion in Section 8). Golden Minerals' geologists have classified the mineralization by oxidation state (Table 7-1).

Coote (2010) observed:

- Tennantite–tetrahedrite is both intergrown with and overgrowing/replacing enargite–luzonite defining a trend of progressively decreasing sulphidation state of acid hydrothermal fluids with time at any given location within the hydrothermal system. The association of minor amounts of very fine-grained chalcopyrite with tennantite–tetrahedrite as overgrowths to or replacement of enargite–luzonite is consistent with the interpreted decreasing hydrothermal fluid sulphidation state. Sphalerite, locally abundant in association with the tennantite–tetrahedrite, formed about or after luzonite–enargite, also formed as a component of the physio-chemically evolving acid hydrothermal system
- Silver is mostly identified (from electron microprobe analyses and reflected light optical properties) as a component of the complex antimony- and lead-bearing and bismuth-rich sulphosalts which span the enargite–luzonite through to predominant tennantite–tetrahedrite paragenesis. It would appear that silver is poor in early bismuth-rich sulphosalts and rich in the later bismuth-rich sulphosalts that are mostly associated with tennantite/tetrahedrite. Silver mineralisation therefore is also genetically associated with the evolving high-sulphidation system. Only minor to trace amounts of argentite are associated with tennantite–tetrahedrite and sphalerite.

Table 7-1: Mineralization Styles by Oxidation State

Oxidation State	Minerals
Oxide (supergene)	Plumbojarosite, argentojarosite, limonite, stibiconite
Mixed (secondary enrichment)	Chalcocite, covellite, argentite, native silver, chlorargyrite: when rimming hypogene sulphides
Sulphide (hypogene)	Pyrite, galena, sphalerite, tetrahedite–-tennantite, complex Pb–Sb–Bi ± Ag sulphosalts, bismuthinite, stibnite, chalcopyrite

Distinctive metal zonation patterns are recognized at Yaxtché. Patterns are broadly defined as a copper–gold assemblage at lower elevations, transitioning upwards into a silver–lead–zinc–barium–antimony metal assemblage at higher elevations. These zonation patterns suggest that physio-chemical gradients had a significant control on localization of silver bearing mineral assemblages. Corbett (2012) proposed that sites of bonanza grade silver mineralization may be a product of fluid mixing along structures as silver-bearing fluids mixed with low pH steam heated waters collapsing down faults.

Figure 7-6 shows a representative cross section through the Yaxtché deposit. Mineralization is controlled primarily by zones of high paleo-permeability. Permeability is controlled by zones of vuggy silica along the Yaxtché structural trend, and is locally focused along dacite dome contacts where rheologic contrasts between the coherent dacite and permeable epiclastic units focused fluid flow. In addition, the intersection of northeast-trending faults and the Yaxtché structure resulted in zones of higher permeability and served as sites of silver-bearing mineral precipitation.

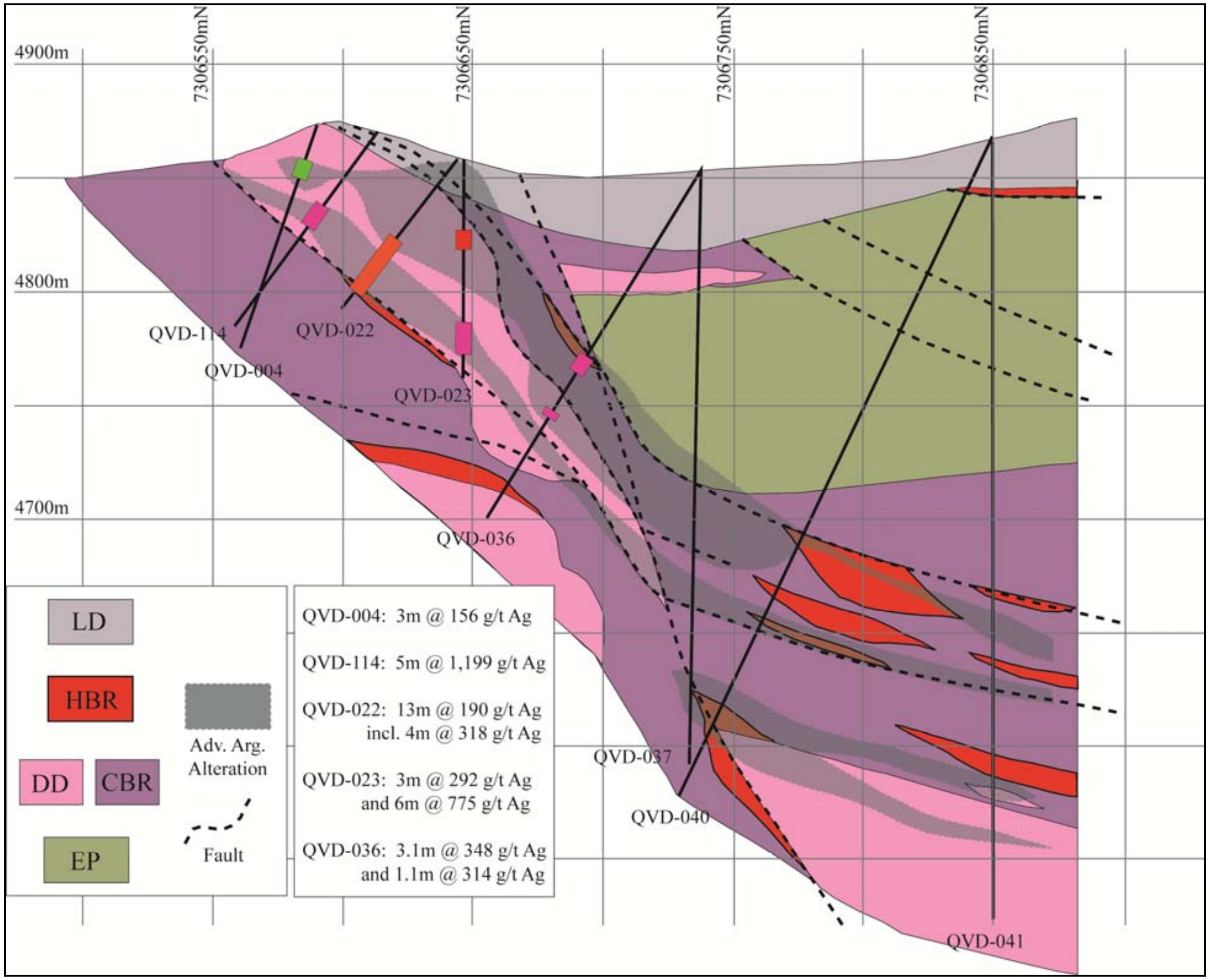
7.4 Prospects/Exploration Targets

Prospects are discussed in Section 9.

7.5 Comments on Section 7

The knowledge of the deposit settings, lithologies, mineralization and alteration controls on silver grades is sufficient to support Mineral Resource estimation.

Figure 7-6: Yaxtché Cross-Section (looking northwest)



Note: Figure courtesy Golden Minerals, 2018; modified after Cummings, 2010.

8.0 DEPOSIT TYPES

Epithermal deposits have been variably classified on the basis of their alteration and gangue mineral assemblages, metal and sulphide contents, and their sulphide mineral assemblages. The Yaxtché deposit shows alteration assemblages typical of high sulphidation epithermal deposits (refer to Section 7.3) whereas the metal content and sulphide assemblages are characteristic of mineralizing fluids with an intermediate sulphidation state (Figure 8-1).

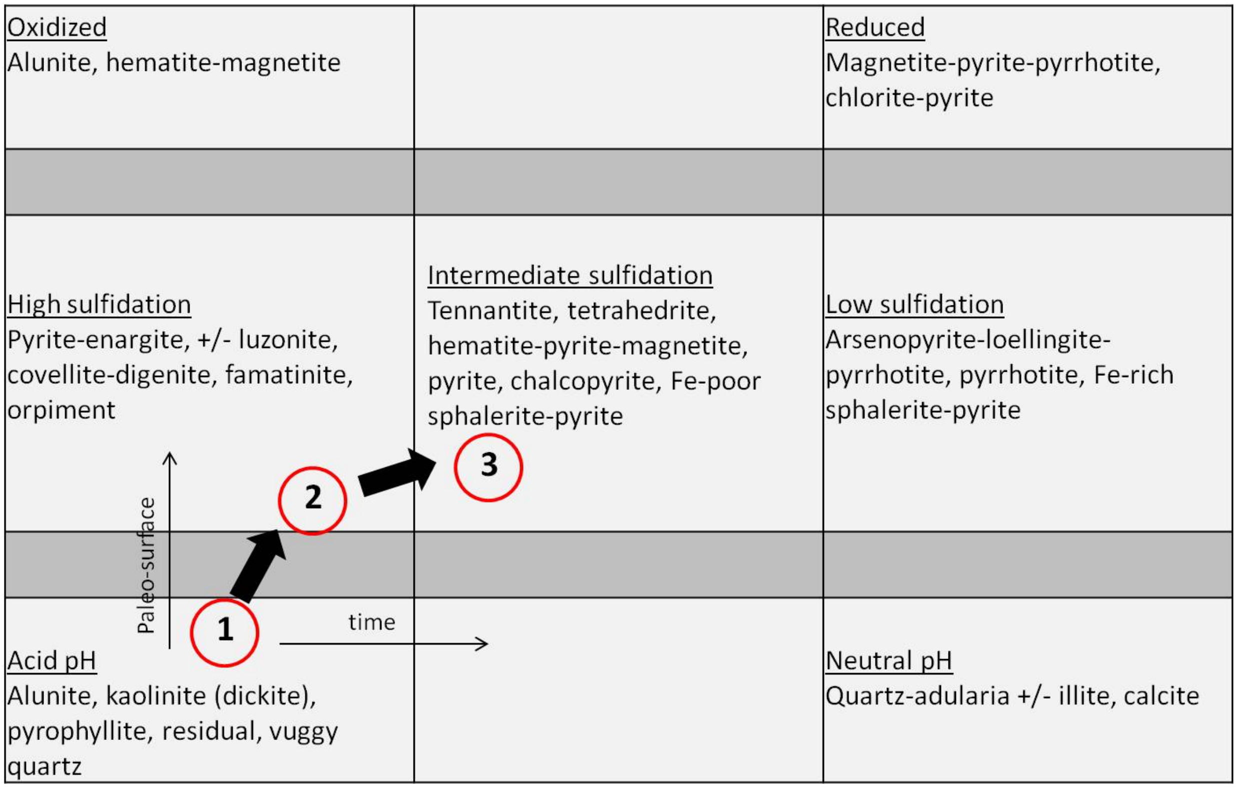
The transition of high to intermediate sulphidation state is thought to define an evolving epithermal system as high sulphidation state metal-bearing fluids cooled and interacted with host rocks as they moved vertically and laterally though the Yaxtché structure. This is depicted in Figure 8-1 with three stages of primary fluid evolution:

- Alteration and gangue mineral assemblages related to acidic magmatic-hydrothermal fluids created permeability through acid leaching (i.e. vuggy silica)
- High sulphidation state mineral assemblages (namely enargite–luzonite–famantanite) and metal contents (copper–gold dominant) formed at lower elevations within the Yaxtché structure
- Transition of high to intermediate sulphidation state as metal-bearing fluids ascended and further interacted with host rocks. The final phase of fluid evolution was critical for precipitation of silver-bearing minerals as tennantite–tetrahedrite became stable.

Sillitoe and Hedenquist (2003) defined the following key features of intermediate sulphidation systems:

- Intermediate sulphidation deposits occur in calc-alkaline andesitic–dacitic arcs, although more felsic rocks can locally act as mineralization hosts
- The arcs typically display neutral to mildly extensional stress states
- Deposits form under acidic, oxidizing conditions within 1 km of the surface and between temperatures of 150º and 250ºC
- Deposits show a large range in metal content and characteristics and can vary along the spectrum from gold-dominant to silver-dominant mineralization
- Although there is a large range of sulphide and sulphosalt minerals, these are dominated by sphalerite with low FeS content, and include galena, tetrahedrite–tennantite, and chalcopyrite. Sulphide abundance can vary from 5–20 vol%

Figure 8-1: Diagnostic Minerals of Various States of Ph, Sulphidation and Oxidation State Used to Distinguish Epithermal Ore-Forming Environments

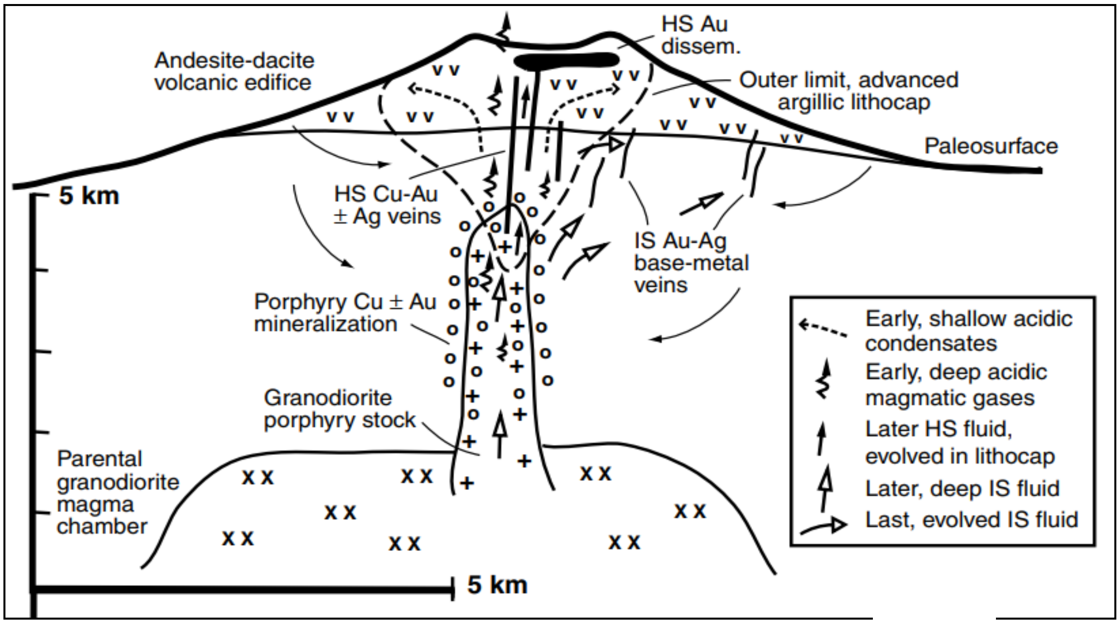


Note: Figure modified from Simmons et al., 2005.

- Mineral assemblages typically contain Ag ± Pb, Zn (Au)
- The typical Ag:Au ratio is > 20:1
- Minor mineral associations can include Mo, As, Sb; may have associated tellurides
- Silica alteration can include vein-filling crustiform and comb textured veins
- Typical alteration assemblages include advanced argillic, alunite and kaolinite with pyrophyllite deeper in the system; the proximal alteration mineral is often sericite

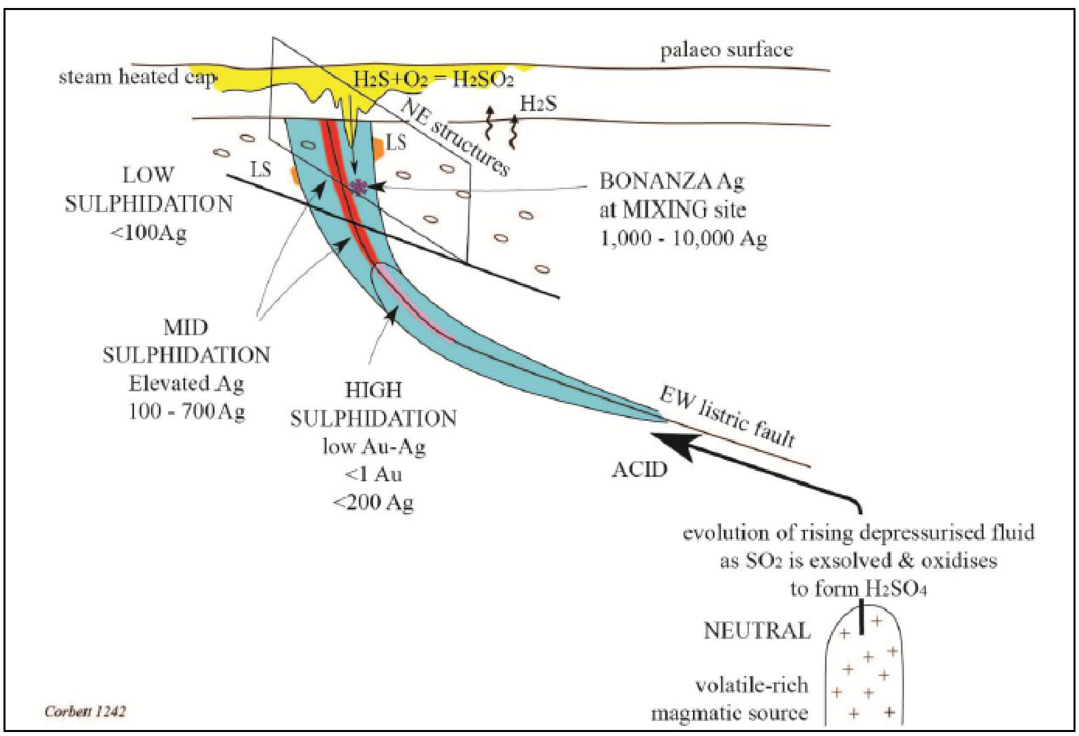
Figure 8-2 is a schematic diagram showing the general geologic setting of high to intermediate sulphidation epithermal deposits. Corbett (2012) related the epithermal model to the Yaxtché silver deposit. Important aspects of this work include the proposed relationship between silver grade and sulphidation state of the metal-bearing fluids including zones of bonanza silver grades where collapsing steam heated waters interacted with metal-rich fluids (Figure 8-3).

Figure 8-2: Schematic, Intermediate Sulphidation System



Note: Figure from Sillitoe and Hedenquist, 2003.

Figure 8-3: Schematic Diagram of Yaxtché Hydrothermal Fluid Evolution



Note: Figure from Corbett, 2012.

8.1 Comments on Section 8

Features that support the Yaxtché deposit as a high-intermediate sulphidation system include the deposit setting, host rocks, and mineralization and alteration assemblages.

The deposit model is a reasonable basis for the design of additional exploration programs.

9.0 EXPLORATION

9.1 Grids and Surveys

Golden Minerals provided topographic control which was acquired by PDOP Servicios Topograficos (PDOP) during May–June, 2008. PDOP used GPS Trimble R3 and Trimble ME Base Station instruments for the survey. The contour interval is 2 m, and the data are reported in the Posgar 94 UTM zone 3 coordinate system.

9.2 Geological Mapping

Geological mapping in the Quevar South area by Silex Argentina was completed at 1:5,000 and 1:10,000 scales during campaigns from 2006 through 2008.

Mapping by G. Cummins in 2010 was completed at 1:2,000 scale and compiled at 1:5,000.

Trench mapping was completed at 1:500 scale.

Mapping of the adit/decline in 2011 was completed at 1:50 and 1:100 scales, and compiled at 1:500 scale.

Geological mapping aided in the exploration effort by identifying the extent of alteration areas related to mineralization and also by identifying the most permissive host unit - the epiclastic breccia volcaniclastic unit. Mapping of post-mineral volcanic units aided in identifying prospective areas beneath unaltered surface exposures, especially in the Yaxtché West area.

A geological map of the Project area was included as Figure 7-4.

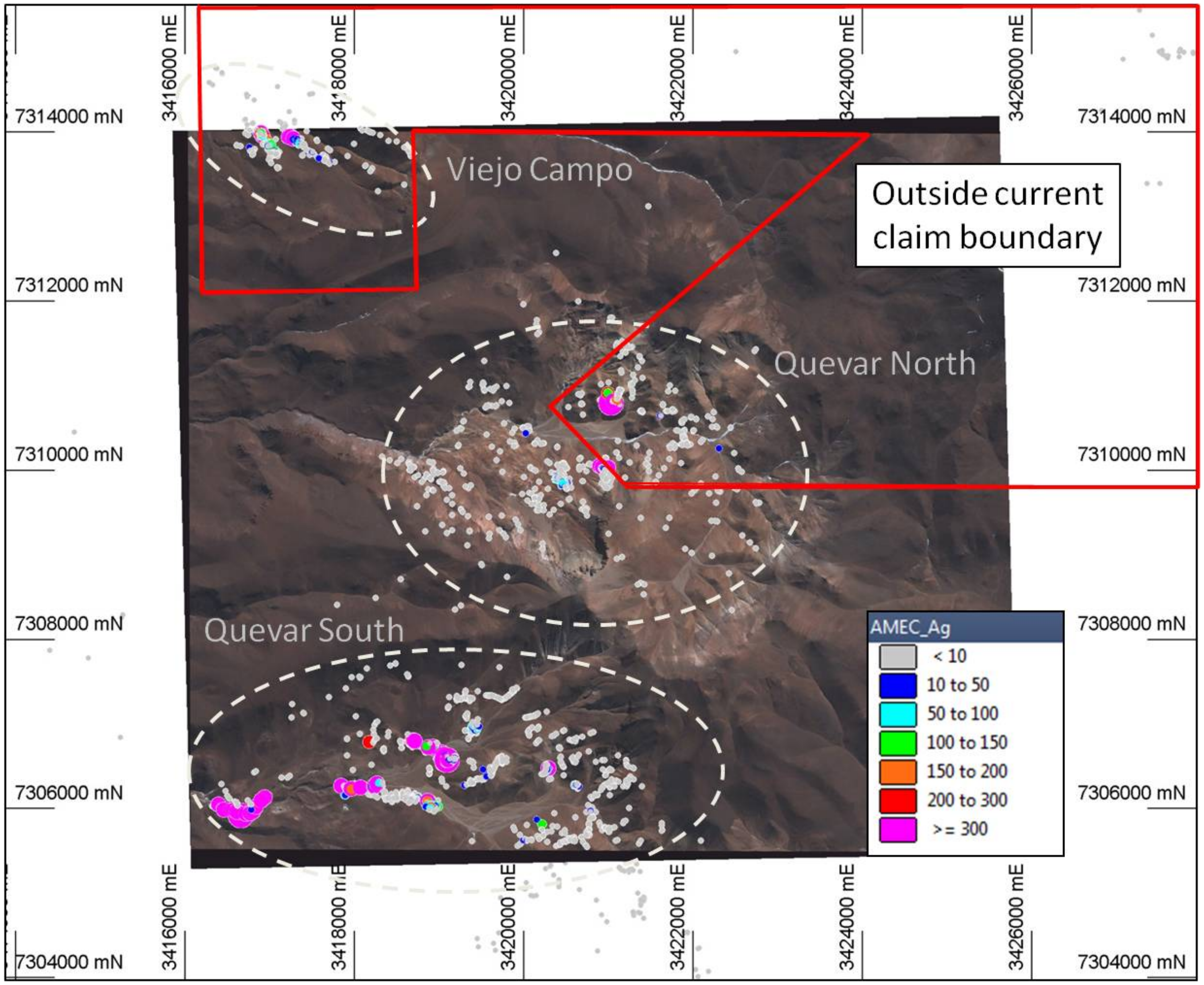
9.3 Geochemical Sampling

Early stage exploration sampling by Silex Argentina included reconnaissance outcrop sampling using channel, panel and select chip samples. Results from this sampling program were used to identify drill targets. In total over 3,100 surface samples have been collected from the project area (Figure 9-1).

9.4 Geophysics

A ground-based geophysical program was completed between December 2007 and February 2008, consisting of an induced polarization (IP)/resistivity with three-dimensional (3D) pole/dipole survey over Quevar South. This work was contracted to Quantec Geoscience Argentina S.A. based in Mendoza, Argentina. Line separation was at 200 m and 400 m with stations at 50 m intervals along lines. The instruments used were an Iris Elrec-6 receiver and an Iris VIP 3000 transmitter. The offset dipole array provided information to approximately 600 m depth at the centre of the survey.

Figure 9-1: Rock Chip Sampling



Note: Figure courtesy Golden Minerals, 2018. Silver assay results are in g/t units.

Results of the IP survey have recently been reprocessed by EarthEx Geophysical Solutions Inc. Reprocessing of the data consisted of a new 3D inversion and interpreted cross sections throughout the survey area. Preliminary results of the interpretation include:

- A well-defined high resistivity and high chargeability anomaly coincident with mineralization at Yaxtché Central (Figure 9-2)
- A conductivity high associated with mineralization at Yaxtché West
- Identification of targets with similar geophysical signatures to those identified at Yaxtché (Figure 9-3)
- Recommendations for additional geophysical work to further define prospective areas.

Golden Minerals personnel are currently reviewing and prioritizing drill targets generated from this work.

9.5 Pits and Trenches

Trenching by backhoe was undertaken in 2007 and 2008 with some encouraging results but it was found that trenching was slow and sometimes encountered thick overburden, so it was discontinued.

In 2007, 16 trenches were excavated (four at Quevar North and 12 at Quevar South) with the aim of identifying and extending the known mineralized areas. Results are compiled in Table 9-1.

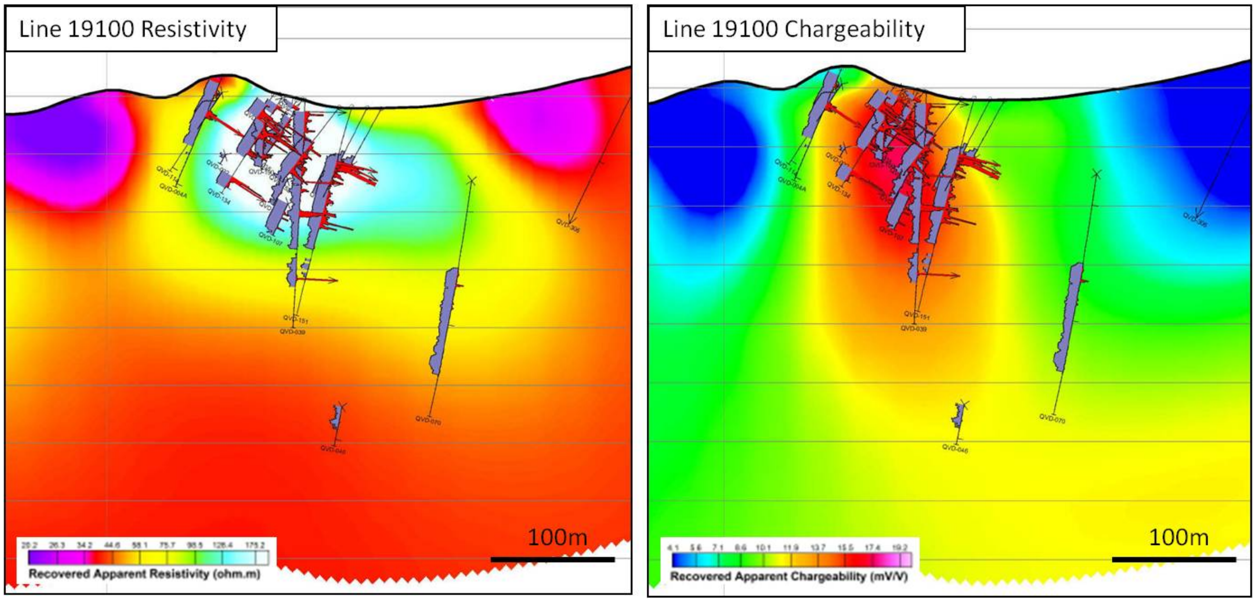
In 2008, approximately 2,800 m of trenching was completed in the Quevar South area with seven trenches targeting the Copán structure and 14 in Yaxtché area. Three trenches returned elevated silver values, two at Yaxtché, and one in the Yaxtché Northeast area.

9.6 Decline/Adit

Information in this sub-section is summarized and updated from Pincock, Allen and Holt (2012).

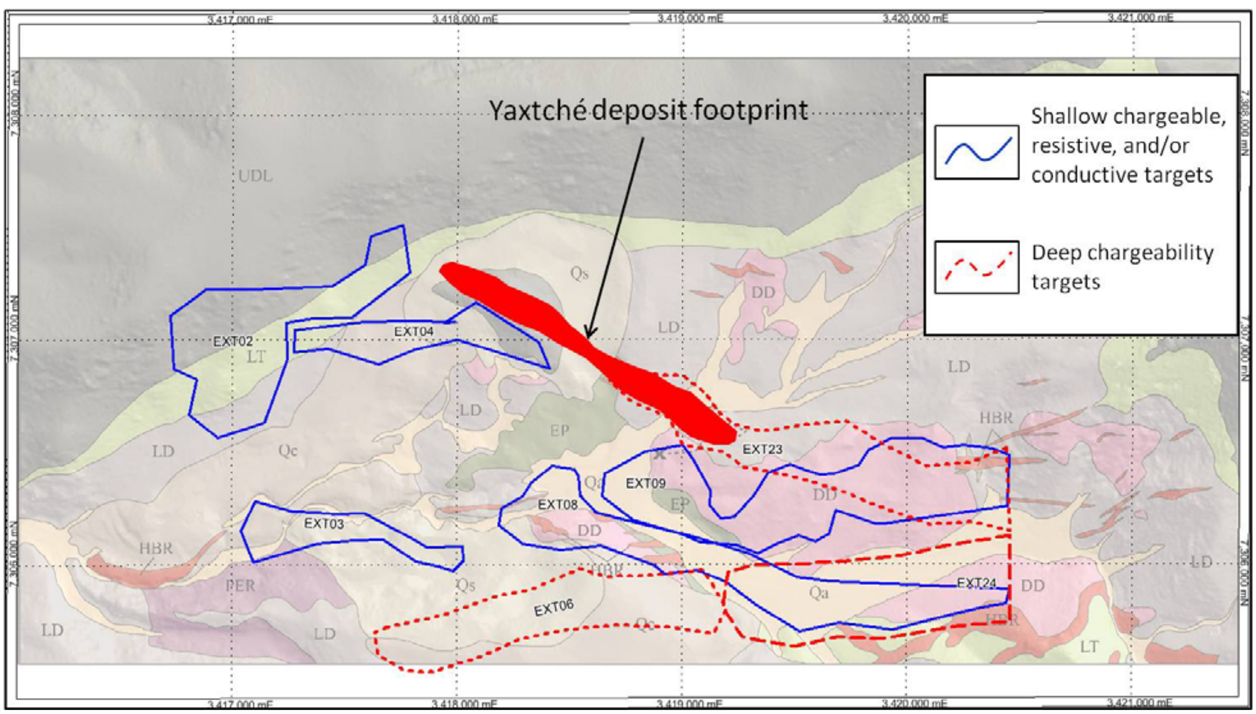
In 2011, Golden Minerals completed installation of an inclined adit to access the eastern part of the Yaxtché zone and to investigate the continuity of the mineralization by drifting, channel sampling, and bulk sampling.

Figure 9-2: 3D Inversion



Note: Figure courtesy Golden Minerals, 2018. Figure shows the resistivity and chargeability anomalies associated with Yaxtché Central. Grey drill hole histograms represent alteration intensity, red histograms represent silver assays (g/t).

Figure 9-3: Quevar South Interpreted Geophysical Targets



Note: Figure courtesy Golden Minerals, 2018.

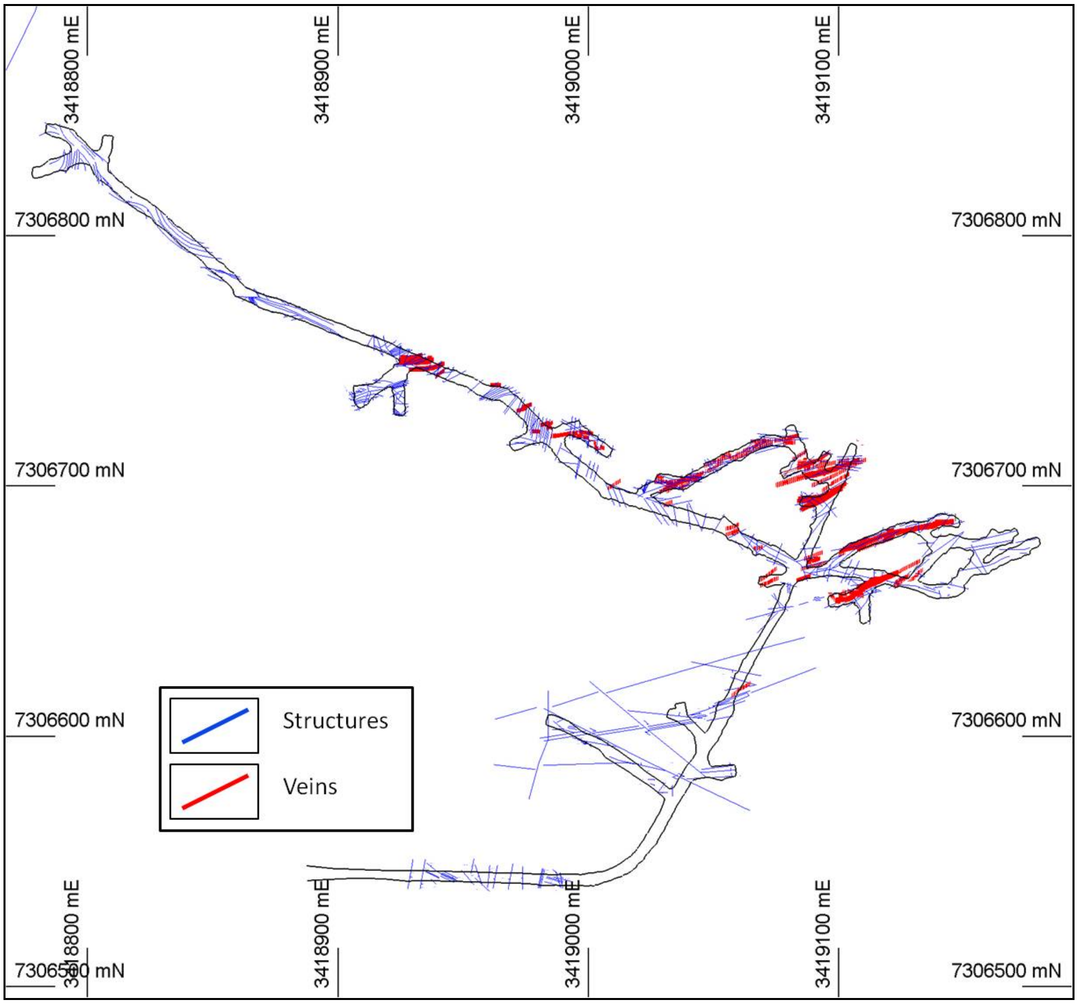
Table 9-1: 2007 Trenching Program

Trench	Location*	Sampled Width (m)	Ag Grade (g/t)	Pb Grade (% Pb)
Ts-001	Yaxtché	No significant values		
Ts-002	Copán	2	40 g/t	0.665
		2	37.46	0.136
Ts-003	Copán	24	87.07	1.72
	Includes	8	145	1.55
Ts-004	Copán	12	413.25	0.397
	Includes	6	694	0.437
		10	45.39	0.418
Ts-005	Quevar South	No significant values		
Ts-006	Yaxtché	No significant values		
Ts-007	Yaxtché	11	387.54	0.175
	Includes	6	649.66	0.249
Ts-008	Yaxtché	No significant values		
Ts-009	Yaxtché	Assays not available		
Ts-010	NE Quevar South	No significant values		
Ts-011	NE Quevar South	No significant values		
Ts-012	Quevar South	Assays not available		
Tn-001	Quevar North	18	41.65	1.6
Tn-002	Quevar North	6	35.8	0.022
Tn-003	Quevar North	No significant values		
Tn-004	Quevar North	No significant values		

The adit decline (main ramp) was driven east then northward 260 m to the 4,774 m level, exploration drifts were completed on mineralized structures and an exploration decline was driven westward (~300º az) from the main ramp along the trend of and beneath the main Yaxtché mineralized structure. The exploration decline was stopped approximately 350 m west of the main ramp in an area of poor ground conditions (clay alteration). In total about 1,250 lineal metres of ramp, decline, and drifts were completed. No underground core drilling was undertaken.

Geological, structural and mineralization logging was completed using face maps at 1:50 and 1:100 scale that were compiled at 1:500 scale (Figure 9-4). Golden Minerals stockpiled and sampled the muck piles produced from each blasted round as the exploration drifts advanced.

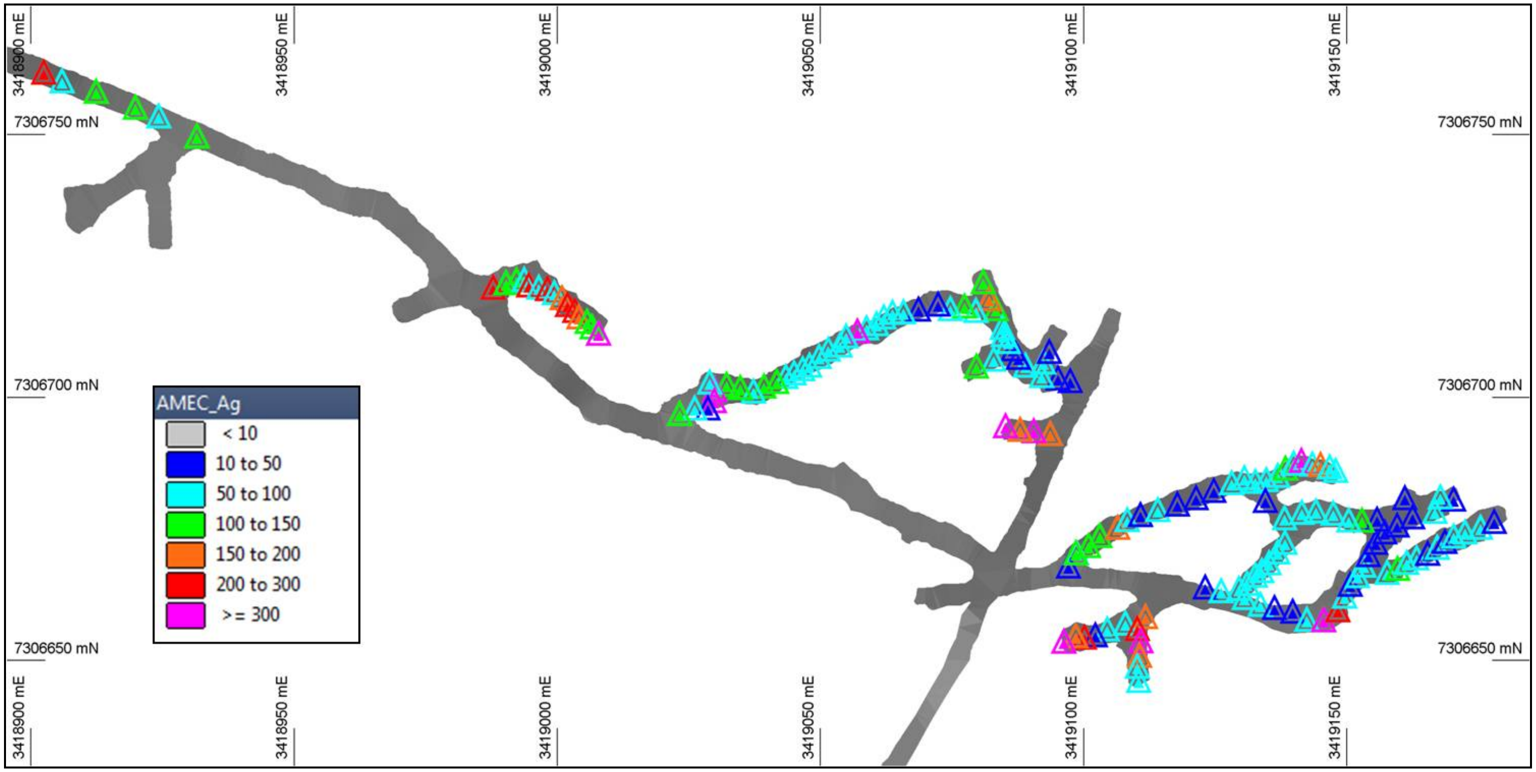
Figure 9-4: Results of Underground Structural Mapping



Note: Figure courtesy Golden Minerals, 2018.

Drifts were a nominal 4 x 4 m with each shot advancing the face approximately 3–4 m. The muck generated by each round was hauled to the surface. Visually-mineralized rounds were stockpiled in discrete, numbered piles which in total comprised approximately 20,000 t of material in 165 piles. Figure 9-5 shows the location and grade of the underground bulk samples. Each pile averaged approximately 121 t. Golden Minerals personnel sampled the stockpiles by digging 4–8 channels down the flank of each pile, and the material from each channel was bagged and sent for analysis. The average silver grade for all piles was 117 g/t.

Figure 9-5: Plan Map Showing Location and Silver Grade of Underground Bulk Samples



Note: Figure courtesy Golden Minerals, 2018. Silver values shown in g/t.

The exploration adit was also designed for future production access and was driven below the main mineralized zone. The higher-grade mineralized material encountered in the adit is hosted in narrow (less than 0.5 m wide) northeast-trending, near-vertical veins shown in red in Figure 9-4. Approximately 40% of the material from the adit was visibly mineralized and stockpiled. The sulphide material from these stockpiles has since been placed in clay-lined trenches to mitigate any possible acidic runoff from oxidation of the pyrite contained in the material.

9.7 Petrology, Mineralogy, and Research Studies

In 2008, Apex Silver submitted 24 samples from six drill holes in the Yaxtché structural zone to Brockway and Franquesa Consultores based in Santiago, Chile, for petrographic and reflected light microscopy work. Host rocks were identified as lithic tuff, volcanic breccia and altered volcanic breccia. Minerals identified in reflected light included pyrite, sphalerite, enargite, tennantite-tetrahedrite, covellite, pyrargyrite, chalcopyrite, galena, native silver and argentite. Fourteen of the 24 samples had additional electron microprobe work for confirmation of mineral species present and further identified argentojarosite and plumbojarosite.

In 2009, petrological and mineralogical examination of eight drill core samples from two diamond drill holes were analyzed by Dr. B.J. Barron, a consulting petrologist. The suite of samples was collected from drill holes QVD-036 and QVD-041, both drilled at the eastern end of the Yaxtché Central area. QVD-036 was drilled within the near-surface mineralized area of the Yaxtché structure, whereas QVD-041 was drilled ~200 m northeast and intersected the structure at a depth well below the primary silver mineralization at Yaxtché Central.

X-ray diffraction (XRD) and field portable spectrographic analyses (PIMA) were reported for the same suite of samples by Lantana Exploration in 2009. The main minerals identified were: quartz, plagioclase feldspar, K feldspar, smectite, illite, kaolinite, dickite, calcite, alunite, pyrite, enargite, and barite. Results indicated that "*the silicate, sulphide, and sulphate mineral components and assemblages are consistent with alteration types that occur in high sulphidation systems*" (Camuti, 2009).

In 2010, 28 samples from 21 holes along the Yaxtché structure were submitted to Applied Petrologic Services & Research in Wanaka, New Zealand. Findings included (Coote, 2010):

- Petrological studies of diamond core from the El Quevar hydrothermal deposit, Salta Province, Argentina determine the distribution of silver-bearing and rich bismuth sulphosalts within a high sulphidation epithermal system to be related to a lateral and vertical variation in sulphidation state, as defined by the distribution of hypogene enargite–luzonite and tennantite–tetrahedrite

- Alteration and mineralization are developed in locally hydrothermally-brecciated and more extensively tectonically shear/fragmented dacite/rhyodacite lithic fragmental textured rocks with compositional and textural variation to indicate the rocks comprise a mix of epiclastic and pyroclastic rocks and possible high-level intrusion breccias. The presence of eutaxitic lithic framework clasts is in support of the presence of pyroclastic rocks along the length of the Yaxtché structure
- Pervasive quartz, alunite, kaolin clay (dickite) and alunite together with pyrite and rutile mostly define acid hydrothermal alteration. The crystallinity of the hydrothermal wall rock replacement and fracture/cavity-fill minerals together with the composition and morphology of fluid inclusions in hydrothermal quartz indicate wall rock interaction with hydrothermal fluids of pH less than four and at temperatures of between 200 and 230ºC
- Abundant enargite, luzonite, tennantite, tetrahedrite intergrown with the acid alteration mineralogy defines a high sulphidation epithermal system. Native gold is intergrown with both enargite–luzonite and tennantite–tetrahedrite. Silver mineralization is mostly in the form of variably silver-rich, complex Ag–Cu–Sb–Pb–Bi sulphosalts that are associated with enargite–luzonite and tennantite–tetrahedrite and related acid alteration mineralogy. Zinc mineralization is defined by sphalerite mostly occurring as intergrowths with tennantite–tetrahedrite together with minor to trace amounts of argentite
- The distribution of silver relative to copper can be related to a spatial and temporal chemical zonation within the high-sulphidation system along the Yaxtché structural trend as defined by the distribution of enargite–luzonite and tennantite–tetrahedrite. The distribution of enargite–luzonite and tennantite–tetrahedrite can be interpreted in terms of a decrease in sulphidation state of hot acid fluids with time and elevation as they travelled upwards and in a north-westerly direction along the Yaxtché structure
- The complex geochemistry of the high sulphidation system, including lead, zinc and silver, might in part be the result of remobilization of metals from a pre-existing mineralized source by hot acid fluids themselves entraining metals of magmatic source.

More recently, 13 polished sections were prepared at Spectrum Petrographics in Vancouver, Washington. The sections were taken from mineralized intervals from seven drill holes along a single cross section from Yaxtché West. Six of the samples have been submitted to Colorado School of Mines for automated mineralogy analysis, using quantitative evaluation of minerals by scanning electron microscopy (QEMSCAN) and this work is ongoing.

The goals of the current study are to:

- Quantify the mineral assemblages for intervals with varying metal contents found at different elevations within the Yaxtché structure
- Provide paragenetic information between different minerals and mineral assemblages.

A preliminary image from this work is provided in Figure 9-6.

9.8 Exploration Potential

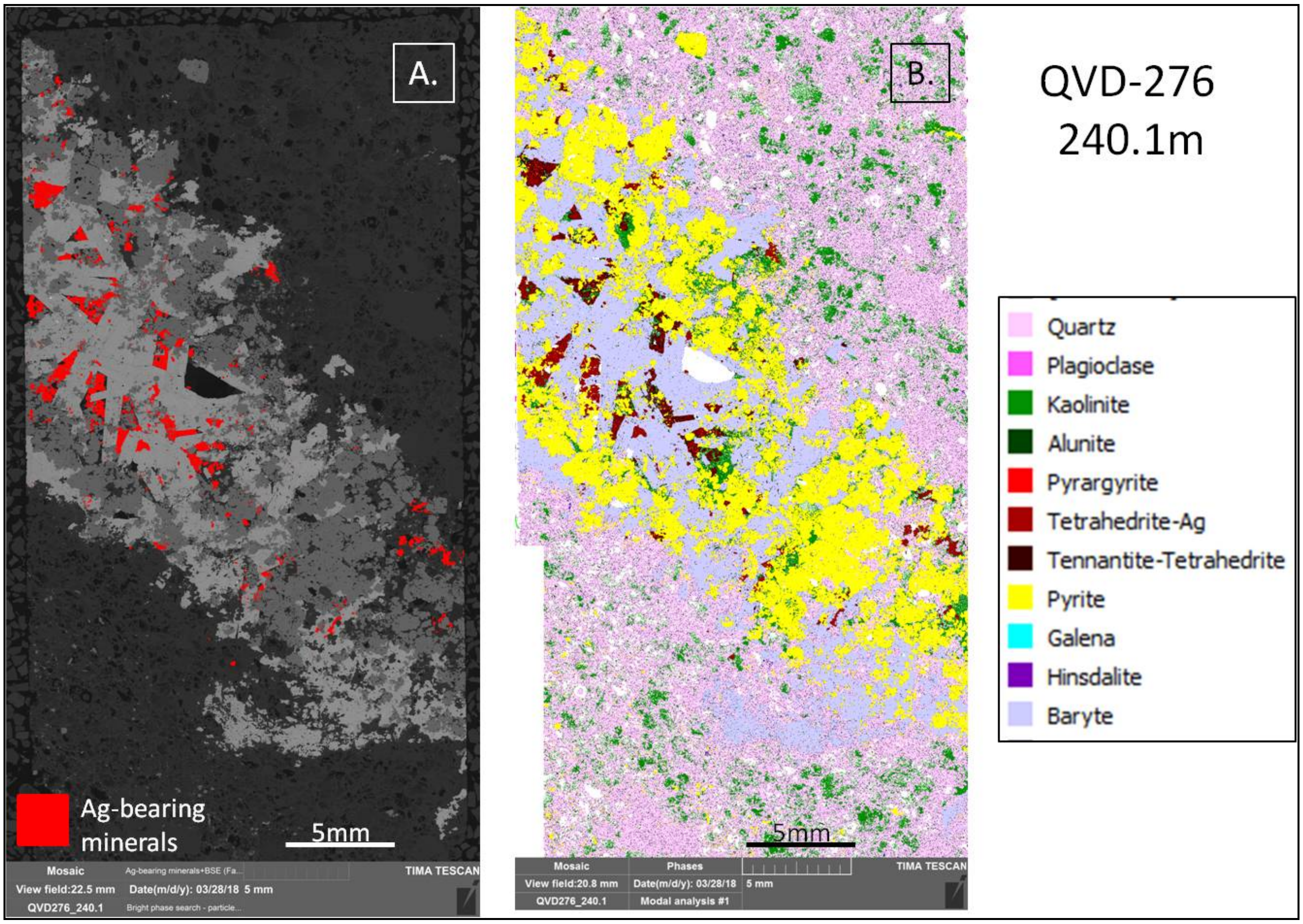
The Yaxtché deposit remains open along strike and several zones adjacent to the resource estimate area have returned significant silver intercepts (Figure 9-7). Perhaps the most significant of these zones, the Yaxtché West extension, is highlighted in Figure 9-8. At approximately 500 m, these holes are among the deepest drilled in the Project area and show that significant widths and grades of silver mineralization continue down plunge of the Yaxtché trend. Drilling conditions in the area are difficult as thick Quaternary landslide deposits cover the bedrock.

Within the greater Quevar South project area, several additional prospects have been identified (Figure 9-9) and remain to be fully tested. These targets have been identified though various efforts, most notably that of Corbett (2009), Corbett (2012), and Spurney et al., (2013). A summary of selected targets is provided in Table 9-2 (after Spurney et al., 2013). These targets are considered to be the highest priority as previous exploration has identified styles of mineralization, alteration, and lithologies similar to those at Yaxtché. Collar information for the drill intercepts mentioned in Table 9-2 is provided in Table 9-3.

9.9 Comments on Section 9

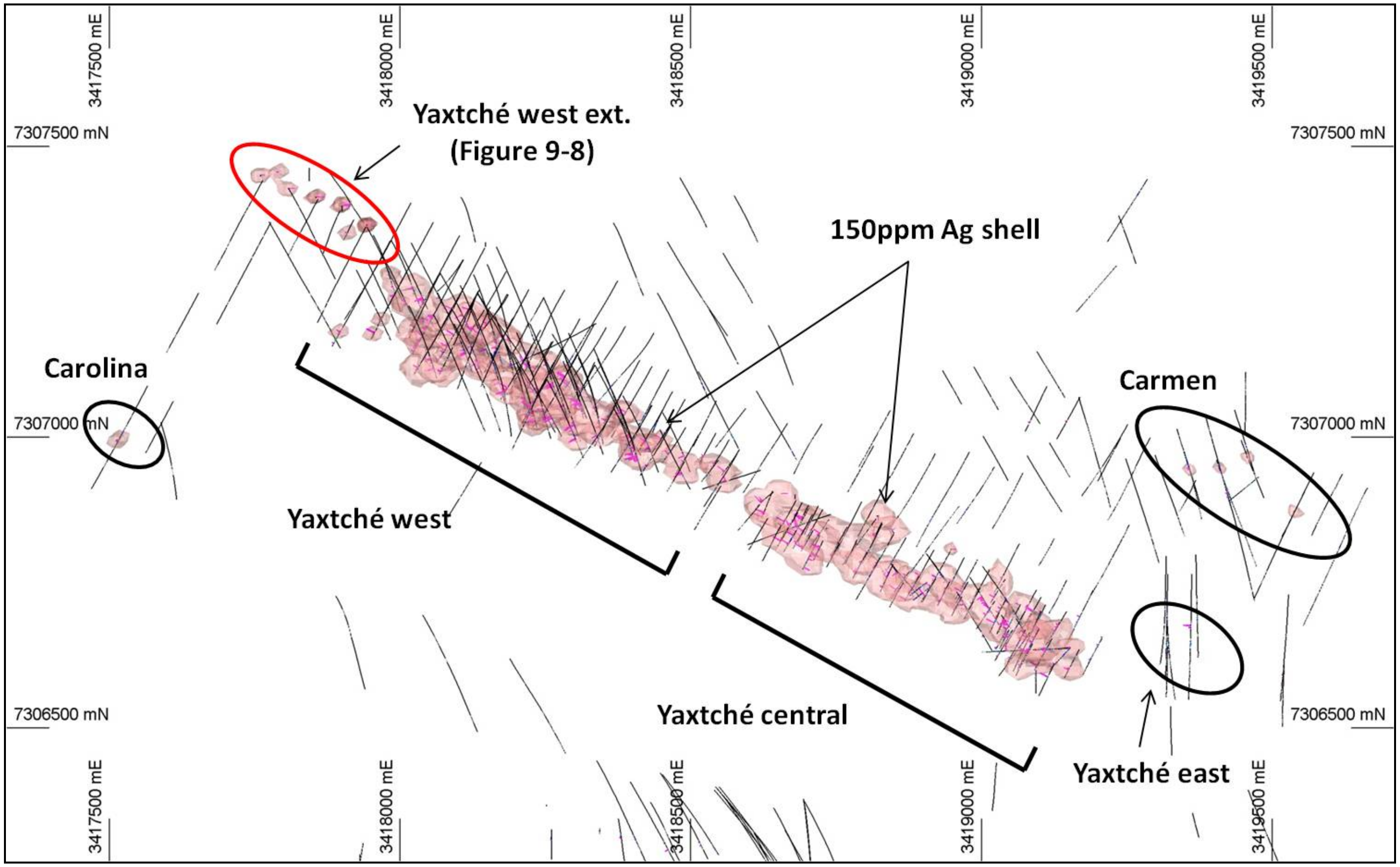
Exploration to date has identified the Yaxtché deposit and a number of regional targets, and the Project retains significant exploration prospectivity.

Figure 9-6: Automated Mineralogy of QVD-276 (preliminary results)



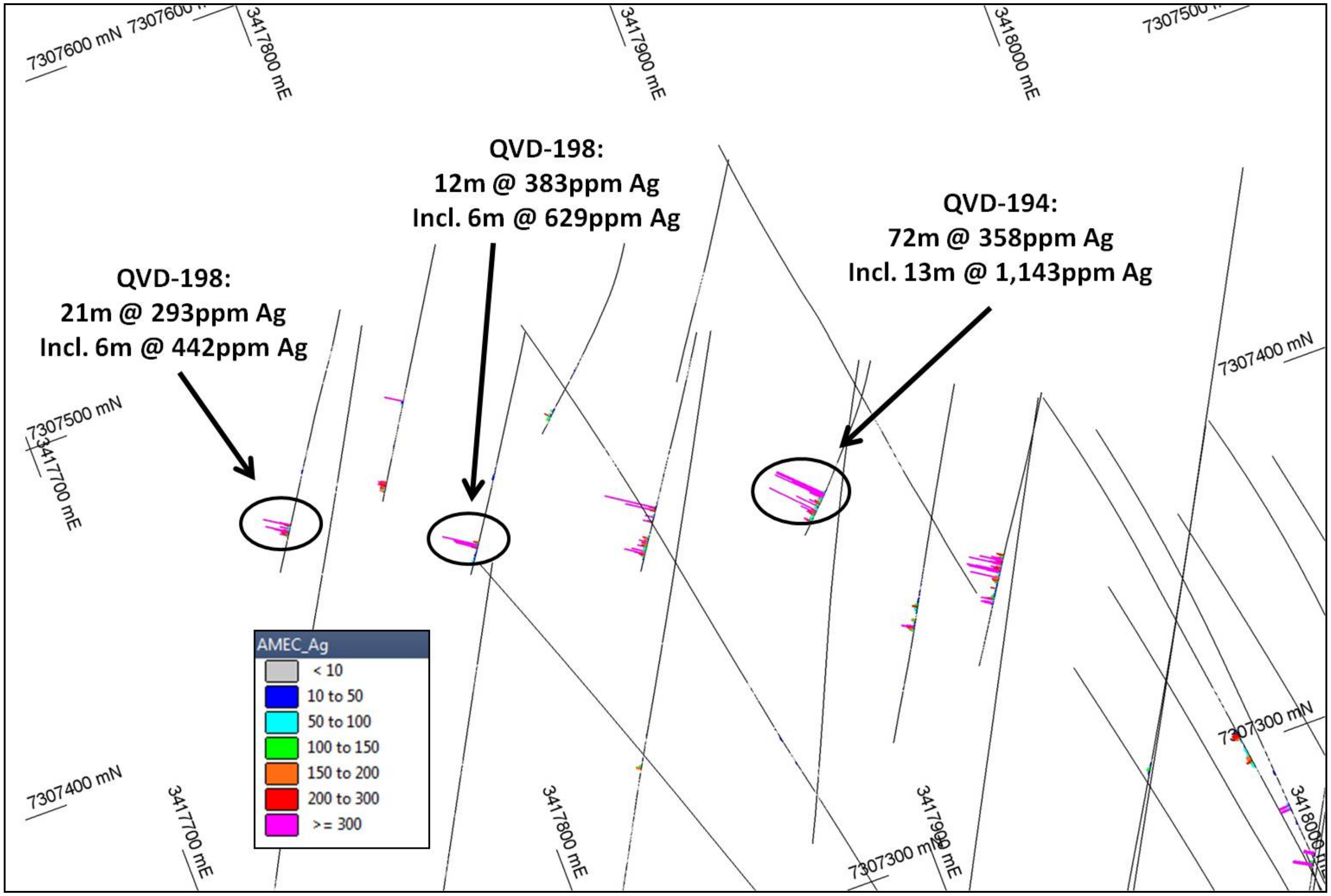
Note: Figure courtesy Golden Minerals, 2018. A. back scatter image, B. false color mineral map.

Figure 9-7: Plan Map Showing Exploration Potential Relative to Yaxtché 150 g/t Ag Grade Shell



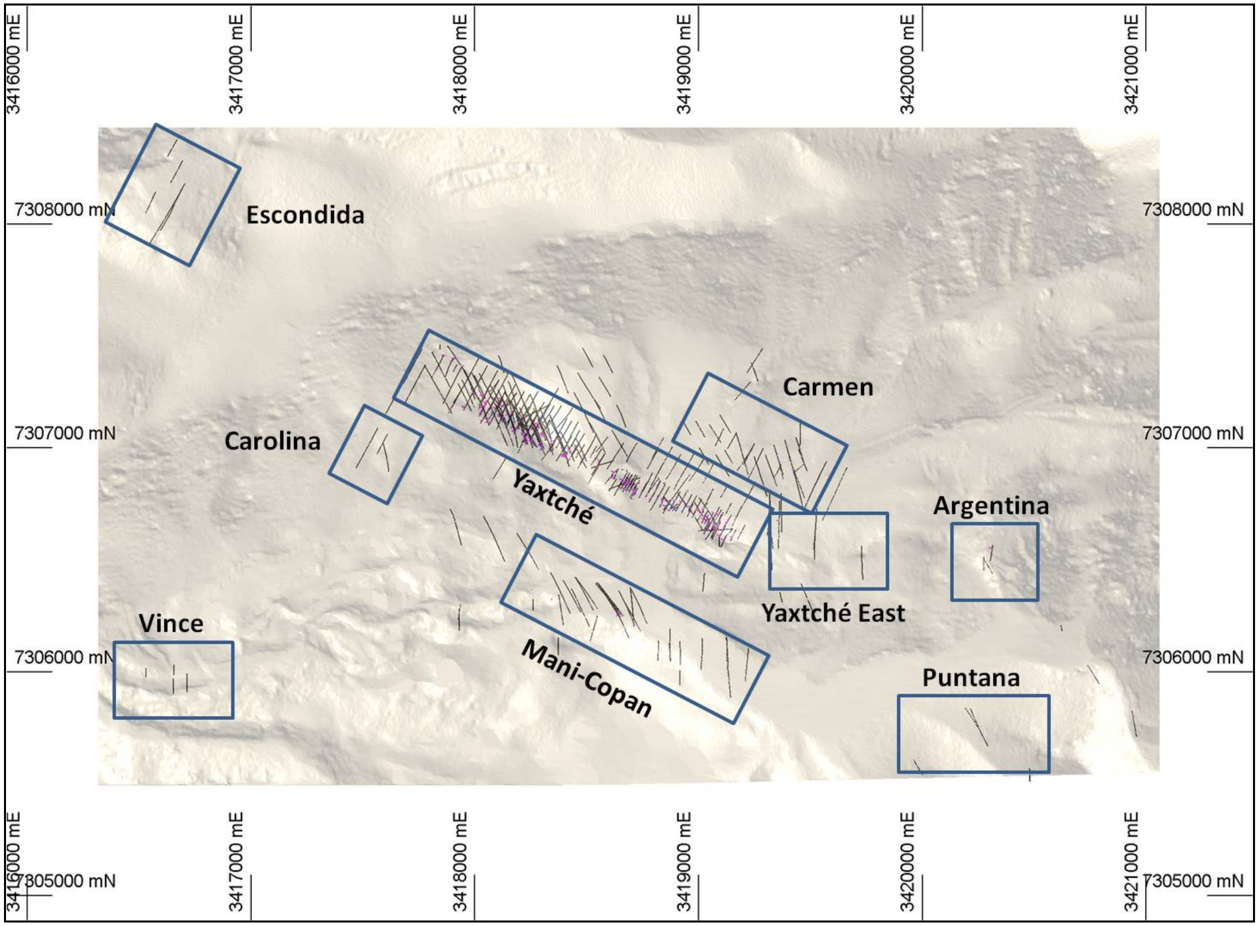
Note: Figure courtesy Golden Minerals, 2018.

Figure 9-8: Slightly Rotated Plan View Showing Selected Intervals Within Yaxtché West Extension Zone



Note: Figure courtesy Golden Minerals, 2018. Section location is provided in Figure 9-7. Silver values in g/t.

Figure 9-9: Identified Prospects Within Quevar South



Note: Figure courtesy Golden Minerals, 2018.

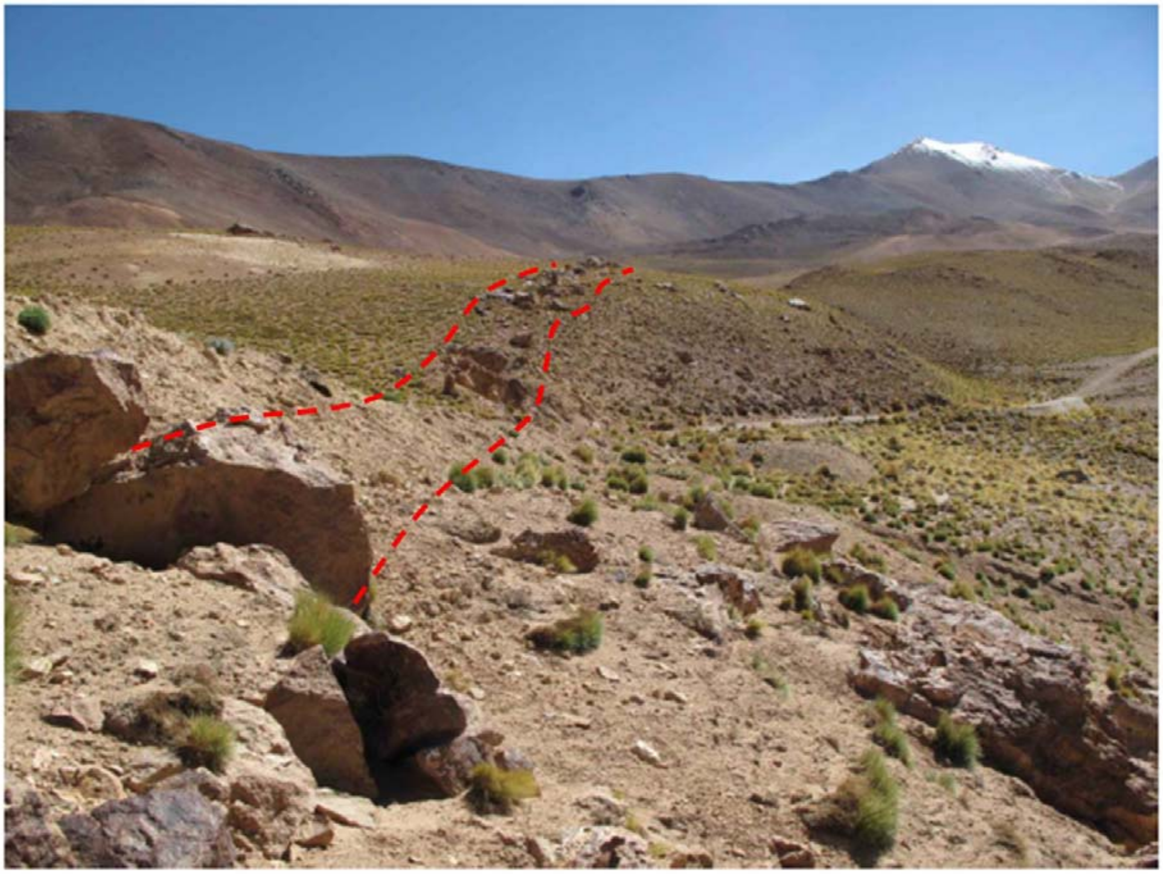
Table 9-2: Prospects Within Quevar South

Prospect	Notes
Yaxtché East	Limited drilling (six holes) has been completed east of the current Yaxtché resource. Significant drill intercepts include QVD-079, drilled approximately 140 m east of Yaxtché central which intercepted 10 m of 145 g/t Ag. A further 50 m east, QVD-217 intersected a 3 m interval grading 659 g/t from 168–171 m, including a 1 m interval of 1,831 g/t Ag. Other drill holes in the vicinity returned only low grade or anomalous silver mineralization, suggesting the geometry and/or controls of mineralization remain uncertain.
Argentina	Located approximately 1,100 m east of Yaxtché Central, the Argentina area has seen only limited exploration consisting of surface mapping/sampling, trenching, and three closely-spaced drill holes (QVD-02, QVD-32, and QVD-378). QVD-378 returned an 8 m wide intercept from 25–33 m grading 779 g/t Ag. The remaining drill holes appeared to have missed the structure altogether with no significant values reported from QVD-02, and a low-grade intercept returned from QVD-32. The interval was hosted in dacite and epiclastics cut by hydrothermal breccias exhibiting silicification and advanced argillic alteration. The zone lies along the eastern strike projection of the Yaxtché mineralized trend, and contains similar lithologies, alteration styles and, potentially, silver grades.
Vince	The exploration target at Vince in map view consists of an arcuate, convex to the south, zone of silicification approximately 800 m long, with silver-bearing, quartz–barite–galena–sulphosalt mineralization in a thick dacite porphyry flow sequence (Figure 9-10). Surface sampling along a linear trend of subcrop has returned strongly anomalous results with many silver values in the 200–2,000 g/t range. Four widely-spaced drill holes testing this zone had varied success with two holes encountering thin zones of silver mineralization including 2 m of 360 g/t Ag from 15–17 m in QVD-011 and 0.8 m of 338 g/t Ag from 14–14.8 m in QVD-013. The remaining holes, QVD-017 and QVD-012 returned only minor anomalous silver values.
Mani-Copan	The Mani structural zone is located approximately 700 m southwest of Yaxtché and was an area of historic silver mining along high grade structures. Sillitoe (1975) reported that small scale historic production was estimated to have produced approximately 3,000 t of averaging 8% Pb and 2,000 g/t Ag. The Mani structure and its southeast extension (known as the Copan target) have been variably defined through surface sampling and drilling over a strike length of approximately 1,100 m. Limited drilling along the strike length has had varied results with intermittent high-grade and barren intercepts. A tight cluster of five drill holes with average spacing of approximately 10 m were collared approximately 650 m from the historic mine workings. These drill holes highlight the locally high-grade nature of mineralization within the Mani structure, with example intercepts including: 6 m of 463 g/t Ag, 0.73% Cu from 326–332 m in QVD-220; and 2 m of 2,960 g/t Ag, 1.6% Cu from 326–328 m in QVD-316.
Carolina	Located 300 m southwest of Yaxtché West and covered by >50 m of overburden, four drill holes have tested the Carolina prospect. Only one of these holes intersected the targeted structure and thus its orientation remains to be defined. Assay results from the Carolina structure include 1 8 m of 193 g/t Ag, 7.8% Pb, 4.5% Zn from 207–225 m in drill hole QVD-237. Within this interval a 2 m wide high-grade zone containing abundant galena and sphalerite returned 583 g/t Ag, 23.8% Pb and 9.5% Zn from 223–225 m. No other drill holes returned significant silver values.

Table 9-3: Drill Intercepts for Selected Intervals Reported in Table 9-3

Drill Hole ID	Easting (X)	Northing (Y)	Elevation (Z)	Azimuth (º)	Dip (º)	Total Hole Depth (m)	Intercept Depth from (m)	Intercept Depth to (m)	Drilled Intersection Length (m)	Grade (g/t Ag)
QVD-079	3,419,324	7,306,615	4,718	173.9	65.3	332.0	165.0	169.0	4.0	15,628
QVD-079	3,419,326	7,306,604	4,692	173.2	65.6	332.0	192.0	199.0	7.0	8,931
QVD-217	3,419,360	7,306,675	4,734	181.2	58.8	420.0	166.0	177.0	11.0	283
QVD-220	3,418,642	7,306,256	4,479	149.2	57.4	359.0	327.0	332.0	5.0	515
QVD-316	3,418,646	7,306,266	4,480	146.9	60.4	371.2	324.0	328.0	4.0	1,489
QVD-378	3,420,313	7,306,551	4,971	187.7	59.5	143.0	25.0	32.0	7.0	860

Figure 9-10: Vince Prospect



Note: Photograph courtesy Golden Minerals. Photograph shows numerous in-line, subcropping blocks containing quartz, barite, galena, and silver sulphosalts that define the mineralized trend along the eastern segment of the Vince prospect. Photograph looks northeast. Due to the perspective view of the photograph, no scale can be provided.

10.0 DRILLING

10.1 Introduction

Two drill programs were completed by Fabricaciones Militares and BHP-Utah Minerals International in the 1970s. Six to seven drill holes appear to have been competed, but metreages are not known. There is no other available information on these programs.

Apex Silver and Golden Minerals completed drill campaigns from 2006–2013 (Table 10-1). These programs total 417 holes for 104,163 m. There has been no drilling on the Project since 2013.

Figure 10-1 is a drill collar location plan that shows all drilling within the Project. Figure 10-2 shows the drilling in the Yaxtché deposit area.

10.2 Drill Methods

Table 10-2 summarizes the drilling companies that completed the core drilling, where known.

Core has primarily been drilled at HQ size (63.5 mm core diameter). Occasional reductions to NQ size (47.6 mm) occurred in areas of poor ground conditions. Two drill holes, QPD-01 and QPD-02, of PQ size (85 mm diameter) were completed in 2011.

10.3 Logging Procedures

10.3.1 2006–2008 Drill Campaign

Information in this sub-section for the 2006–2008 drill campaigns is summarized from SRK (2009).

Core was placed in wooden boxes at the rig, and moved to the core shed under the supervision of an operations chief or a technician. The core was either in the custody of the drilling contractor or Silex Argentina at all times.

The technician recorded hole number, start and end intervals, and marked up metre intervals on the core boxes. Geotechnical information such as recovery, rock quality designation (RQD) and mechanical and physical fracture frequency was recorded.

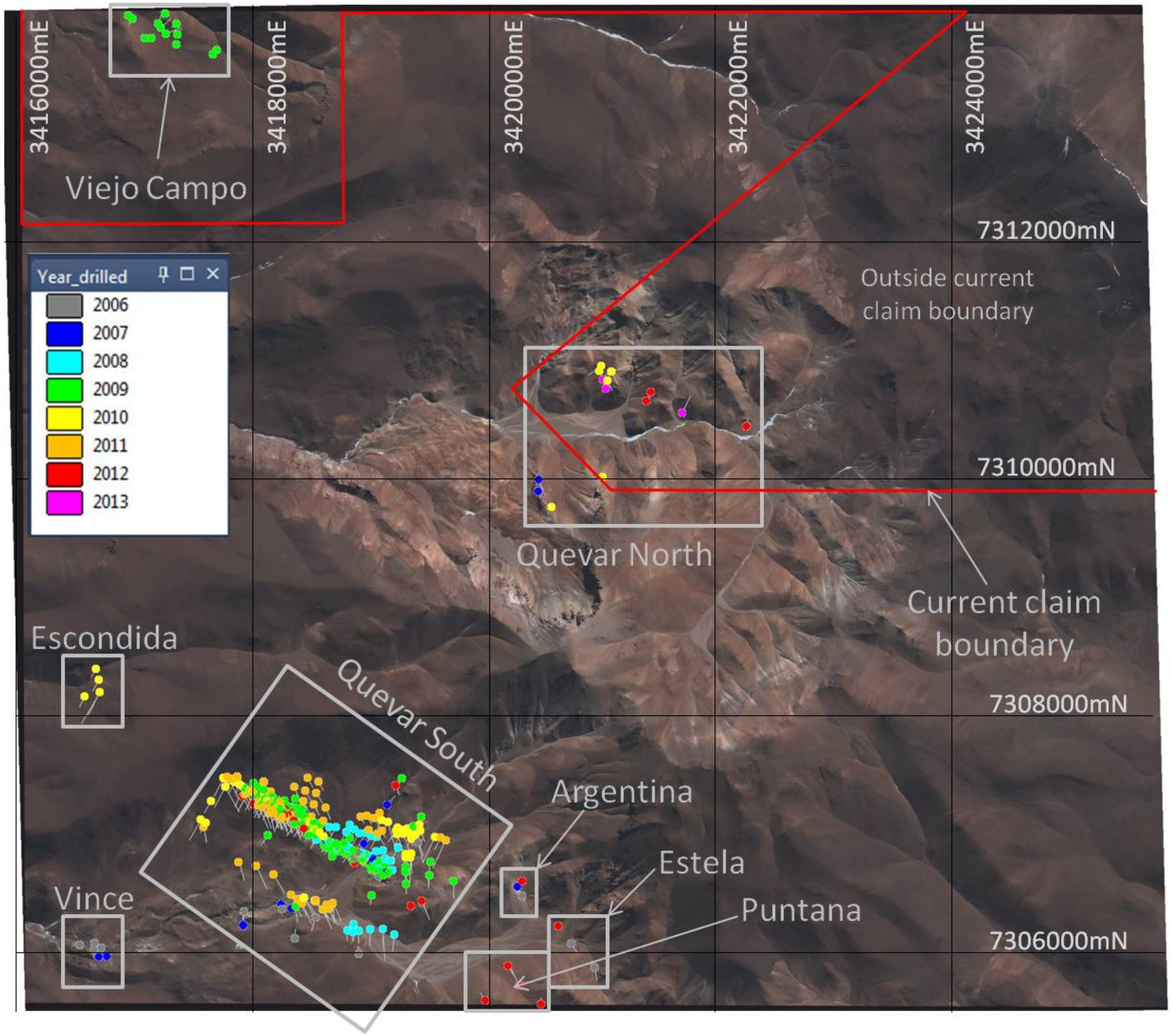
Geological logging was completed on paper sheets and later transferred to a database. The paper log had sections for comments and a graphic log with a separate area for drawing fractures. Mineralization, alteration and alteration intensity were recorded on the log sheet and there was an area for sample interval, sample number and analytical results. The geologist marked the core for any additional observations including PIMA measurements.

Table 10-1: Drill Program Summary Table

Year	Company	Number of Drill Holes	Metres Drilled
1970s	Fabricaciones Militares	3 or 4	Unknown
1970s	BHP-Utah Minerals International	3	Unknown
1997	Minera Hochschild	6	582
2006	Apex Silver	19	2,377
2007	Apex Silver	19	2,482
2008	Apex Silver	43	10,651
2009	Apex Silver	114	23,111
2010	Golden Minerals	67	20,302
2011	Golden Minerals	118	37,792
2012	Golden Minerals	28	6,434
2013	Golden Minerals	3	432
		417	***104,163***

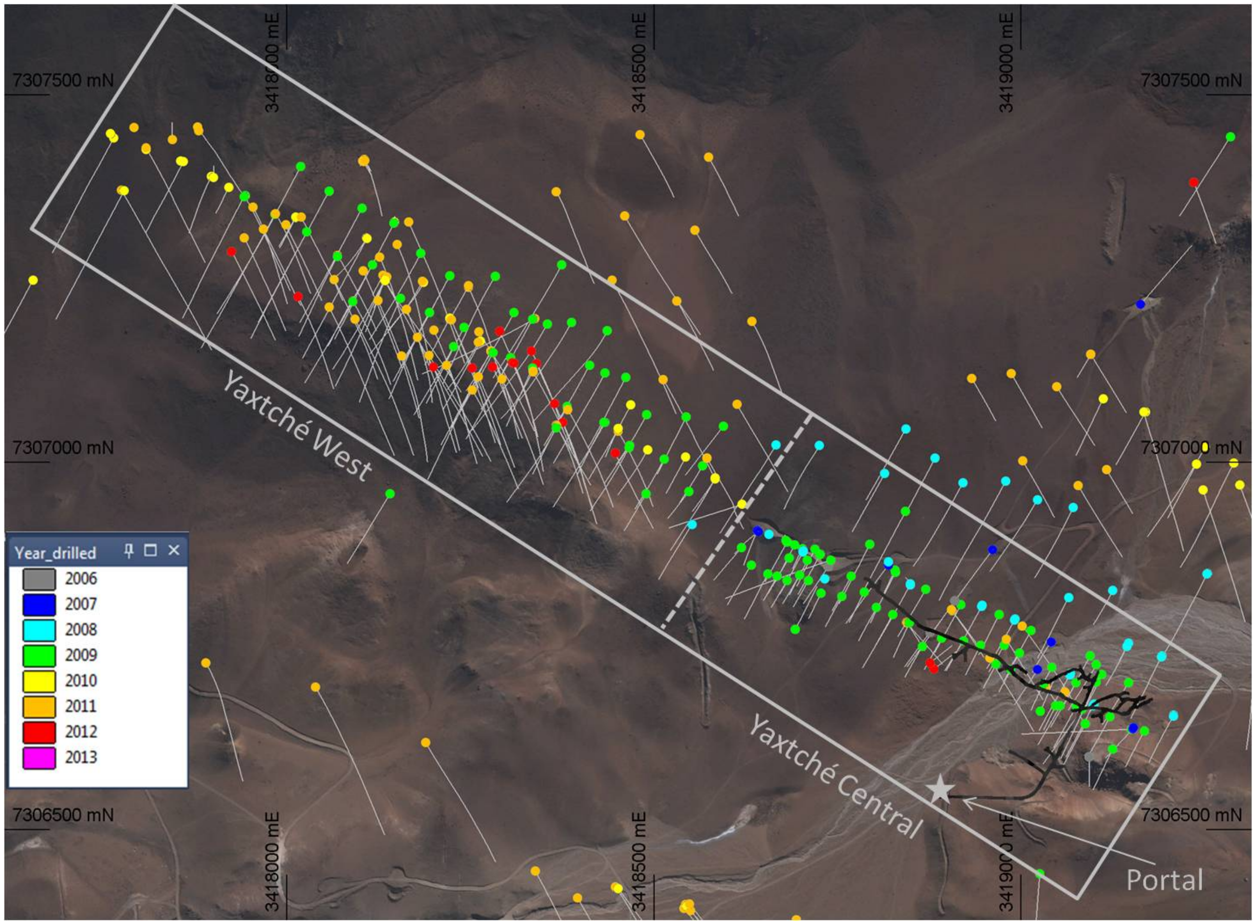
Note: totals do not sum due to uncertainties with legacy information from the 1970s. Totals reflect only Apex Silver and Golden Minerals drill programs.

Figure 10-1: Regional Drill Hole Location Plan



Note: Figure courtesy Golden Minerals, 2018.

Figure 10-2: Yaxtché Deposit Drill Hole Location Plan



Note: Figure courtesy Golden Minerals, 2018.

Table 10-2: Drill Companies

Year	Drilling Company
2006	Major Perforaciones S.A.
2007	Bolland Minera S.A.
2008	Patagonia Drill Boart Longyear Falcon Drilling Ltd.
2009	Boart Longyear
2010	Major Perforaciones S.A.
2011-2012	Major Perforaciones S.A.
2012-2013	Major Perforaciones S.A.

A paper file was maintained for each stored drill hole with a checklist for each item that must be completed for every hole and included in the file. This included a hole summary, geological log, geotechnical log, analytical results, drill reports, certificate from the surveyor, photographs, downhole survey information and density measurements.

Core was photographed.

10.3.1 2009 Drill Campaign

Micon (2010) and Chlumsky, Armbrust & Meyer (2009a, 2009b, 2010) noted no differences in the logging procedures for the 2009 drill programs to those described by SRK (2010).

10.3.2 2010 Drill Campaign

Pincock, Allen and Holt (2012) reported no differences in the logging procedures for the 2010 drill programs to those described by SRK (2010).

10.3.4 2011–2012 Drill Campaign

Pincock, Allen and Holt (2012) reported no differences in the logging procedures for the 2011–2012 drill programs to those described by SRK (2009). Lithology and alteration codes evolved in the 2011–2012 campaign as an effort was made to reconcile lithologies and alteration observed in surface mapping (Cummings, 2010) to the lithologies and alteration encountered in core.

10.3.5 2012 Re-Logging Campaign

Between April and August of 2012, 113 drill holes in the Yaxtché zone were re-logged on 29 cross sections spaced about 50 m apart, spanning the Yaxtché area. The purpose of the re-logging program was to standardize logging codes and facilitate reinterpretation of the Yaxtché zone. The drill database was updated with geological codes based on the re-logging effort. Generation and interpretation of geological and geochemical cross sections at 1: 1,500 scale was completed. as well as level plan maps in order to show the trend in the distribution of mineralization.

10.3.6 2012–2013 Drill Campaign

Methodology of drill core handling, logging and sampling followed the procedures described from the 2006–2008 campaign with the exception that PIMA spectral analysis was not completed, nor were collar survey certificates included in the drill hole documentation. The collar coordinates of these exploration drill holes were acquired using handheld GPS units. No drilling in this campaign was located in the Yaxtché area. Lithology and alteration codes followed the units defined in the 2012 relogging campaign.

10.4 Recovery

Table 10-3 summarizes core recovery by year. The average core recovery for all Quevar drill holes averages 93.9% for over 30,000 measured intervals and is consistent with that reported in earlier technical reports.

10.4.1 2006–2008 Drill Campaign

Information in this sub-section for the 2006–2008 drill campaigns is summarized from SRK (2009).

Core recovery was stated to be 90% or better.

10.4.2 2009 Drill Campaign

Micon (2010) and Chlumsky, Armbrust & Meyer (2009a, 2009b, 2010) also reported recoveries of >90%.

10.4.3 2010 Drill Campaign

Micon (2010) and Chlumsky, Armbrust & Meyer (2009a, 2009b, 2010) also reported recoveries of >90%.

10.4.4 2011–2012 Drill Campaign

Pincock Allen and Holt (2012) reported core recoveries of over 90%.

10.4.5 2012–2013 Drill Campaign

Core recoveries for the 2012–2013 drill program averaged 94%.

Table 10-3: Density Determinations

Year	Avg. Recovery (%)	# Measurements
2006	89.3	1,209
2007	86.1	1,342
2008	95.6	3,544
2009	92.3	6,892
2010	95.4	6,215
2011	94.7	8,628
2012	94.0	1,718
2013	93.9	223

10.5 Collar Surveys

10.5.1 2006–2008 Drill Campaign

Information in this sub-section for the 2006–2008 drill campaigns is summarized from SRK (2009).

Drill sites were located using a handheld global positioning system receiver (GPS) by a Silex Argentina technician. At the completion of the drill hole, the collar location was verified by the operations chief using a GPS instrument. Yaxtché drill holes from the 2006–2008 campaign were surveyed in by PDOP Servicios Topograficos (PDOP). PDOP used a Trimble model R3 GPS and a Trimble model M3 total station for drill collar surveying. The collar coordinates were provided in the POSGAR 94 coordinate system using a Gauss Kruger projection.

10.5.2 2009 Drill Campaign

Drill sites were located using a handheld global positioning system receiver (GPS) by a Silex technician. At the completion of the drill hole, the collar location was verified by the operations chief using a GPS instrument. Yaxtché drill holes from the 2006-2008 campaign were surveyed in by PDOP Servicios Topograficos (PDOP). PDOP used a Trimble model R3 GPS and a Trimble model M3 total station for drill collar surveying. The collar coordinates were provided in the POSGAR 94 coordinate system using a Gauss Kruger projection.

10.5.3 2010 Drill Campaign

2010 collar survey protocols remained the same as in 2009 with the exception that the surveys were performed by Golden Minerals personnel using a Trimble model R3 GPS and a Trimble model M3 total station for drill collar surveying rather than using an outside contractor. No survey certificates were placed in the drill hole files, however the surveyed locations were entered into the database.

10.5.4 2011–2012 Drill Campaign

The 2011–2012 collar survey protocols remained the same as in 2009, with the exception that the surveys were performed by Golden Minerals personnel rather than an outside contractor. The same survey equipment was used, collar locations were entered into the database, but no survey certificates or documentation were placed in the drill hole files.

10.5.5 2012–2013 Drill Campaign

Exploration drill holes for the 2012–2013 campaign were outside of the Yaxtché resource area and the collar coordinates were acquired using handheld GPS units.

10.6 Downhole Surveys

10.6.1 2006–2008 Drill Campaign

Information in this sub-section for the 2006–2008 drill campaigns is summarized from SRK (2009).

After completion of a drill hole, the drilling contractor performed a downhole survey. During the 2008 drilling program, Falcon Drilling Ltd., provided a Sperry Sun and Patagonia Drill provided a Reflex Photobor. Downhole surveys were taken at 25 m intervals and checked by an operations chief.

10.6.2 2009 Drill Campaign

Micon (2010) and Chlumsky, Armbrust & Meyer (2009a, 2009b, 2010) reported that down-hole surveys were performed on all drill holes, generally using a Reflex Photobor and in some cases a Sperry Sun. Readings were made at 25 m intervals.

10.6.3 2010 Drill Campaign

Micon (2010) and Chlumsky, Armbrust & Meyer (2009a, 2009b, 2010) reported that down-hole surveys were performed on all drill holes, generally using a Reflex Photobor and in some cases a Sperry Sun. Readings were made at 25 m intervals.

10.6.4 2011–2012 Drill Campaign

Pincock Allen and Holt (2012) noted no differences in the downhole survey instrumentation or reading intervals procedures for the 2010–2011 drill programs to those described by Micon (2010) and Chlumsky, Armbrust & Meyer (2009a, 2009b, 2010).

10.6.5 2012–2013 Drill Campaign

Major Perforaciones reportedly used a Reflex magnetic survey tool to collect downhole survey readings at 25–50 m intervals.

10.6.6 Magnetic Declination

The general protocol was that drill holes and down-hole surveys used magnetic north, with no correction for declination.

During a site visit in April 2018 a spot check of down-hole survey data revealed that some of the earliest drilling may have had magnetic declination corrections applied. It is recommended that all survey information be reviewed to ensure that the data are being presented on the same basis.

10.7 Sample Length/True Thickness

Most holes in the Yaxtché deposit were drilled so as to cross-cut the mineralized zone at a high angle in terms of dip, and nearly all holes were at right angles to the strike of the mineralized Quevar Breccia. The average angle of intercept was approximately 80°.

Pincock Allen and Holt (2012) observed that drill collar azimuths were variable:

- 158 holes (58%) were oriented on an average azimuth of 209º
- 69 holes (25%) were oriented at an average azimuth of 155º.

The remaining 43 holes ranged from vertical (15) to 180º azimuth to variable azimuths.

The principal azimuth of 209º was oriented perpendicular to the strike of the mineralized Quevar Breccia (300º az).

In 2011, Golden Minerals changed the drilling azimuth to 155º perpendicular to the 60–70º strike of extensional structures noted in the adit and associated underground workings. It was later noted that the drill holes drilled on the 155º azimuth encountered the mineralized structure at greater depth and had the same mineralized thicknesses, indicating that holes with the 155º azimuth were cutting the principal structure on an oblique angle (Pincock Allen and Holt, 2012).

Due to the nature of the mineralization occurring as shoots and veins, the true width of the mineralization will vary both along strike and in the down dip direction. In areas where the strike and dip of the mineralization are well established, a true width for the mineralized intersection may be estimated. However, in areas of poor surface exposure or where there is no drilling or poor drilling, the true width of the mineralization cannot be estimated.

10.8 Summary of Drill Intercepts

A drill section through the deposit illustrating the typical drill orientations in relation to the mineralization is illustrated in Figure 7-6.

Table 10-4 provides a selection of the drill intercepts encountered in the Yaxtché deposit. All drill holes are within the 150 g/t Ag wireframe used in Mineral Resource estimation.

10.9 Comments on Section 10

In the opinion of the QP, the quantity and quality of the lithological, collar and down-hole survey data collected in the exploration and infill drill programs completed at the Yaxtché deposit since 2007 are sufficient to support Mineral Resource estimation.

Table 10-4: Drill Intercept Summary Table, Selected Intercepts

Drill Hole ID	Easting (X)	Northing (Y)	Elevation (Z)	Azimuth (º)	Dip (º)	Total Hole Depth (m)	Intercept Depth from (m)	Intercept Depth to (m)	Drilled Intersection Length (m)	Approximate True Thickness (m)	Grade (g/t Ag)
QVD-077	3,418,823	7,306,864	4,661	94.8	87.7	231.6	188.6	200.6	12.0	9.0	336
QVD-129	3,419,027	7,306,692	4,771	208.0	62.2	82.0	57.0	82.0	25.0	24.4	57
QVD-133	3,419,074	7,306,664	4,836	208.4	53.0	107.0	6.0	10.0	4.0	4.0	405
QVD-177	3,418,023	7,307,182	4,617	204.6	65.5	281.0	252.0	256.0	4.0	3.8	216
QVD-196	3,418,143	7,307,191	4,542	218.1	78.8	383.6	335.7	340.6	5.0	4.4	180
QVD-264	3,418,179	7,307,174	4,586	209.2	72.3	404.0	295.0	310.0	15.0	13.9	521
QVD-301	3,418,420	7,306,991	4,680	157.2	64.4	327.0	199.0	217.0	18.0	15.5	34
QVD-343	3,418,161	7,307,168	4,617	165.4	64.5	402.0	267.0	271.0	4.0	3.6	154
QVD-343	3,418,165	7,307,151	4,580	165.7	64.3	402.0	308.0	312.0	4.0	3.6	245
QVD-348	3,418,224	7,307,031	4,551	163.4	65.5	389.3	364.3	370.3	6.0	5.3	284
QVD-361	3,418,307	7,307,064	4,670	158.8	71.4	320.4	221.3	233.3	12.0	10.3	693

11.0 SAMPLE PREPARATION, ANALYSES, AND SECURITY

11.1 Sampling Methods

11.1.1 Core Sampling

The logging geologist was responsible for selection of sample intervals and samples for density measurements.

The geologist logging the core marked the sample intervals on the core. Generally, the sample intervals were a nominal 1 m length within the mineralized zone, but could be longer or shorter due to a lithological boundary. Outside the mineralized zone, samples were typically 2 m in length. Sample lengths within the mineralized zone were a nominal 1 m, but may vary due to changes in lithology. The entire mineralized zone was sampled, and 2 to 3 m shoulder was sampled on either side of the mineralized zone. Silex Argentina personnel did not always sample the entire length of the drill hole. In some drill programs such as the 2012 drill program, a 10–15 m shoulder was sampled; in others such as the 2009 program, the shoulder interval was 2–3 m.

If necessary, the geologist could also draw a longitudinal cut line on the core to guide the sample technician in splitting the core. Drill core was split using a core saw in competent zones and a trowel in broken zones.

11.1.2 Adit Sampling

Golden Minerals conducted an extensive 1 m, chip–channel sampling program in the adit/decline and associated underground workings. The sampling consisted of chip–channels cut at the mining face, in the roof, ribs, and fault zone as exposed in the workings.

The bulk sampling is outlined in Section 9.6.

11.2 Density Determinations

SRK (2009) noted that at the time, there had been 209 density determinations completed on core samples from 17 drill holes using the water displacement method. The following steps were taken when determining sample density:

- Core samples 10 cm in length were selected at a frequency of about 10 to 15 m downhole
- Samples were dried and if necessary, coated with varnish to make the sample impermeable

- The rock type and oxidation state were noted on the data sheet as well as the length of the sample and whether it was whole or half core
- The scale was set to 0 and the core sample was weighed
- A graduated test tube was filled 1,000 mL of water, and the level was noted on the data sheet
- The sample was placed in the water and the water level was noted
- The density was calculated according to the following equation:
  - Weight of Rock (g) / (Volume of water (mL) – Volume of sample (mL)).

During 2009, Golden Minerals measured an additional 600-plus samples from previous and current drilling, most of which were from outside the Yaxtché Central Zone, using the same methodology (Chlumsky, Armbrust & Meyer, 2010). Chlumsky, Armbrust & Meyer noted that the measurement protocol used by Golden Minerals did not meet rigorous quality standards:

- Very small samples, often only 10 cm long, are used
- 24-hour oven drying of samples at 105º C prior to measurement is not called for
- The procedure of varnishing samples to seal against porosity does not accurately represent the volumes of breccias containing large open spaces
- The criteria for selecting samples is not specified rigorously, and could possibly lead to selection of the least-fractured (and therefore most-dense) rock for measurement.

Chlumsky, Armbrust & Meyer was of the opinion that further work needed to be done to accurately determine the bulk densities of the various rock types. It was recommended that more rigorous procedures be used to ensure that samples are thoroughly dry and that volumes are accurately measured (e.g. by sealing cores in cellophane).

Chlumsky, Armbrust & Meyer prepared a scatter diagram, showing bulk density as a function of downhole distance below collar. There was no significant correlation between density and depth.

Overall, Chlumsky, Armbrust & Meyer considered that the data could support Mineral Resource estimation.

Micon (2010) reported that Golden Minerals had updated and improved its density data with a new set of samples analyzed by SGS Peru S.A.C. (SGS Peru). A total of 190 samples from the mineralized zone were submitted for specific gravity testing in July, 2010. The values from the SGS Peru testing are summarized in Table 11-1.

11.3 Analytical and Test Laboratories

Laboratories used during the drill and sampling campaigns are summarized in Table 11-2.

11.4 Sample Preparation and Analysis

11.4.1 Alex Stewart

The sample preparation procedure (P-5) consisted of the following steps:

- Receiving and checking sample identification numbers against submittal form
- Weighing
- Primary and secondary crushing to 80% passing 10 mesh
- Splitting in a riffle splitter to 800 g +100 g
- Grinding to 85% passing 200 mesh
- 200 g sample placed in a sample envelope.

The samples were analyzed for 39 elements by inductively coupled plasma (ICP); method ICP-MA-390) with four acid digestion of a 0.2 g sample. The lower and upper detection limits for silver in this package were 5 and 2,000 ppm, respectively. All samples were analyzed for silver and gold by fire assay of a 50 g sample with gravimetric finish for silver (method AG4A-50) and atomic absorption (AA) finish for gold (method Au450). The lower detection limit was 2 ppm for silver and 0.01 ppm for gold.

11.4.2 ALS Chemex

The sample preparation procedures (Prep-31) consisted of the following:

- Receiving and checking sample identification numbers against the submittal form
- Weighing
- Crushing to 70% passing 10 mesh
- Splitting to 250 g
- Pulverizing to 85% passing 200 mesh
- Placing sample in sample envelope.

Table 11-1: SGS Peru Specific Gravity Test Results Statistics

Description	Specific Gravity
Samples	190
Average	2.60
Mode	2.65
Min.	2.01
Max.	3.97
Q1	2.41
Q3	2.76
Stand. Dev.	0.28

Table 11-2: Analytical and Preparation Laboratories

Year	Laboratory	Accreditation	Independent	Function
2006–2011; 2012–2013	Alex Stewart (Mendoza)	ISO 9001:2000	Yes	Sample preparation and analysis; check sampling for high-grade Ag samples
2006–early 2009	ALS Chemex (Lima)	ISO 9001:2000; Instituto Nacional de Normalizacion Chile ISO 17025.Of2005	Yes	Sample preparation and analysis
2009–2011	Acme (Mendoza)	IRAM – RI 9000-t 295 certification	Yes	Sample preparation and analysis
2010	TSL Laboratories Inc. (Saskatoon)	ISO/IEC Standard 17025 Guidelines	Yes	Witness samples taken by Micon
2010	SGS Peru (Lima)	ISO 9001; ISO/IEC Standard 17025 Guidelines	Yes	Sample analysis, density determinations
2012	American Assay Laboratories (Nevada)	ISO/IEC 17025:2005	Yes	Check laboratory for high-grade Ag samples

Samples were analyzed for 33 elements by ICP (ME-ICP61) using four acid digestion, with lower and upper detection limits for silver of 0.5 and 100 ppm, respectively. The silver over-limits were analyzed by fire assay with AA finish (Ag-AA62) with lower and upper detection limits of 1 and 1,500 ppm, respectively. The resultant over-limits were analyzed by fire assay with gravimetric finish (AG-GRA22) with lower and upper detection limits of 5 and 10,000 ppm, respectively.

Gold was analyzed by fire assay with AA finish (Au-AA24) with lower and upper detection limits of 0.005 ppm and 10 ppm, respectively; gold over-limits were analyzed by fire assay with gravimetric finish (Au-GRA22), with lower and upper detection limits of 0.05 and 1,000 ppm respectively. Over-limits of lead, zinc, and copper were analyzed by AA following a multi acid digestion.

11.4.3 Acme

The sample preparation procedures (R-200) consisted of the following:

- Receiving and checking sample identification numbers against the submittal form
- Weighing
- Crushing to 80% passing 10 mesh
- Splitting to 250 g
- Pulverizing to 85% passing 200 mesh
- Placing sample in sample envelope.

Samples were analyzed for 39 elements by ICP-MS (Group 1DX) analysis. Sample splits of 0.5 g were leached in hot (95º C) aqua regia. The silver over-limits were analyzed by gravimetric finish (AG-G6-Grav) with lower and upper detection limits of 5 and 10,000 ppm, respectively. Gold was analyzed using method Au-GRA22, with lower and upper detection limits of 0.05 and 1,000 ppm respectively. Over-limit samples of lead, zinc, and copper were analyzed by 7AR following a multi-acid digestion.

11.4.4 SGS

Less than 1% of the samples in the database were sent to SGS.

Samples were analyzed for 39 elements by ICP-MS (Group IDX) analysis. The silver over-limit analyses were analyzed by fire assay with gravimetric finish (AG-G6 -Grav) with lower and upper detection limits of 5 and 10,000 ppm. Gold was analyzed (Au-GRA22), with lower and upper detection limits of 0.05 and 1,000 ppm respectively. Over-limit samples of lead, zinc, and copper are analyzed by 7AR with a multi-acid digestion.

11.5 Quality Assurance and Quality Control

No internal quality assurance and quality control (QA/QC) program was in place until drill hole QVD-043. The early analytical programs rely upon the internal Alex Stewart laboratory QA/QC program.

The QA/QC program instigated by Apex Silver could use two types of blanks, three types of duplicates, six precious metal standard reference samples (SRMs) and four base metal SRMs.

The QA/QC program used for surface samples (channel, panel and select outcrop samples), consisted of a SRM, coarse blank, and pulp blank at a frequency of one per 50 samples or approximately 2%. For drill core, Apex Silver included one SRM every

20 samples (5%), a coarse duplicate every 20 samples (5%), a pulp duplicate every 20 samples (5%), a core duplicate every 50 samples (2%), and a pulp blank and coarse blank every 20 samples (5%).

SRK (2009) noted that the precious metals SRMs and coarse blank samples were site-specific. The precious metals SRMs were generated from material collected at the site and prepared by Alex Stewart. Coarse blank material was collected from a fresh dacite flow located approximately 3.5 km southeast of the camp. The flow is younger than the mineralization host at Yaxtché.

The fine blank material was purchased from Alex Stewart. The base metal SRMs were purchased from Geostats Pty Ltd., and were certified.

The QA/QC samples were inserted into the sample stream in two steps. At the El Quevar camp, coarse blanks and core duplicates were inserted into the sample shipment. The samples were taken to Salta by Apex Silver, and then shipped to either ALS Chemex or Alex Stewart for sample preparation. Each laboratory prepared the sample for analysis, after which all sample materials were returned to Silex's Mendoza office. Silex stored the reject materials, renumbered the samples, inserted the remaining QA/QC samples and submitted the pulps for analysis to the respective laboratories. Pulps prepared by ALS were returned to ALS for analysis and likewise pulps prepared by Alex Stewart were returned to Alex Stewart for analysis. The QA/QC samples submitted into the sample stream at this time included SRMs, pulp duplicates and pulp (fine) blanks.

The sampling completed under Golden Minerals continued with the same insertion rates and materials as the Apex Silver programs for both drill and underground sampling programs.

11.6 Databases

The current database is maintained on Golden Minerals main server in Golden, CO which is a mirrored multi-disk array, and which is also backed up every three days to an external drive, and stored offsite.

11.7 Sample Security

The drill core was maintained in a facility at the El Quevar campsite, before and directly after splitting. The cores shed was not locked; however, the overall facility has locked access and was under guard 24/7.

Older core was stored on pallets at the campsite. Golden Minerals or Apex Silver personnel were responsible for logging, sampling, splitting and shipping core to the laboratory facilities.

11.8 Comments on Section 11

Sample collection, preparation, analysis and security for underground sampling and core drill programs conducted since 2007 are in line with industry-standard methods for epithermal silver deposits.

Specific gravity data are measured from unwaxed core samples using the water displacement method. There are sufficient estimates to support tonnage estimates for the various lithologies.

Drill and underground sampling programs included insertion of blank, duplicate and SRM samples.

QA/QC program results do not indicate any problems with the analytical programs (refer to discussion in Section 12).

The QP is of the opinion that the quality of the silver analytical data is sufficiently reliable to support Mineral Resource estimation without limitations on Mineral Resource confidence categories.

12.0 DATA VERIFICATION

12.1 Internal Data Verification

Golden Minerals' internal procedures for the collar, lithology, alteration, and survey data include detailed re-survey of collar locations, re-checks on logged lithology and alteration, including re-logging of drill holes and correcting overlapping intervals when noted.

12.2 SRK (2009)

SRK did not observe active drilling because, at the time of the 2009 site visit, all drill programs had been completed. SRK found the completed drill pads to be clean and marked as described. The core logging and storage facilities at El Quevar were described as being clean and well organized, enabling Apex Silver staff to easily locate reference core and supporting data.

SRK completed the following checks:

- Visits to each of the exploration targets with examination of trenches, outcrops, and drill pads
- Examination of drill core and logging and sampling procedures
- Comparison of lithological logs to database
- Comparison of assay certificates to 10% of the database, with no errors detected
- Review of cross-sections and geologic model
- Review and analysis of laboratory QA/QC procedures and results.

SRK did not identify any errors in the database and found the drilling and logging procedures to meet industry standards

12.3 Chlumsky, Armbrust & Meyer, LLC (2009a, 2009b, 2010)

Chlumsky, Armbrust & Meyer completed a digital check of the database provided by Golden Minerals in 2009. In evaluating an existing database Chlumsky, Armbrust & Meyer used values flagged by these automated procedures as a starting point for database review, and noted that if the error rates in the statistically-anomalous values were acceptable then the entire database was generally acceptable.

Some anomalies were noted as part of the review, and were forwarded to Golden Minerals, but the number and type of anomalies were within industry norms for databases of this size, and even if the anomalies turn out to be errors, they would have no effect on the overall resource estimate.

On the basis of these statistical checks Chlumsky, Armbrust & Meyer was of the opinion that the Yaxtché Central Zone exploration database had been prepared according to industry norms and was suitable for the development of geological and grade models.

The second database check later in 2009 and the 2010 evaluation found no significant database errors and the Yaxtché exploration database was concluded to have been prepared according to industry norms and was suitable for the development of geological and grade models.

12.4 Micon (2010)

Micon also visited the Golden Minerals/Silex offices in Salta where the exploration and development program was discussed. Two days were spent on site where the core logging, sampling and assaying procedures and techniques were discussed, and the general exploration, drilling, QA/QC and development programs were reviewed. During the visits to the offices and to the Project site, the database was reviewed for any errors and omissions. During the 2010 Micon site visit, the drill pads for the drilling program underway at the time were inspected and a number of the drill hole collars were located. Micon noted that the drill sites were very clean.

During the site visit to the Project eight samples were taken by Micon, six of which consisted of reject samples from the drilling program, and two were grab samples from two mineralized outcrops on the Yaxtché zone. Micon arranged for its samples to be analyzed for gold, silver, copper, lead and zinc. All assaying was conducted by TSL Laboratories Inc. (TSL) of Saskatoon, Saskatchewan, a laboratory that was independent of Golden Minerals and registered to ISO/IEC Standard 17025 Guidelines. There was a general agreement between the assay results obtained by Golden Minerals and Micon for the reject core samples. In addition, Micon's grab samples from two mineralized outcrops in the Yaxtché area both indicated elevated silver grades, and in one sample there was an elevated lead grade as well. Micon concluded that the independent sampling confirmed the presence of silver mineralization at Yaxtché.

During the initial site visit, Micon reviewed the database and found a small number of data entry errors. Micon asked Golden Minerals to correct these errors prior to reviewing the model and conducting the 2010 resource estimate. During a second visit, Micon verified the data included in the updated database and assisted Golden Minerals with the creation of a new interpretation for the mineralized solids upon which the 2010 updated resource estimate for the Yaxtché deposit was based.

Micon performed a random check of assays against laboratory certificates and a review of the database during the site visits and was satisfied that the database at the time was sufficiently complete and free of errors to allow its use in the preparation of a mineral resource estimate.

12.5 Pincock, Allen and Holt (2012)

During the 2012 site visit to the El Quevar property, Pincock, Allen and Holt (2012) observed and interviewed Golden Minerals personnel in the procedures of core handling, sampling, logging and sample security that are performed at the Project base camp, noting:

- Processing and sampling of core is performed in a well-appointed metal building at the El Quevar camp. The facility has separate rooms for a geology office, core cutting and a large area for laying out, sampling and storage of core
- The handling and sampling of core is industry standard
- Core is laid out, washed, measured from block to block to determine recovery
- A technician marks-up sample intervals for bulk density measurements every 4–6 boxes, and performs RQD measurements
- The geologist lays out the 1 m sample intervals and logs the core. The practice is to sample 10–15 m above and below the mineralized zone. Core is cut by a diamond saw into 1 m samples weighing about 2-3 kg and bagged. Sample tags are fixed on the inside and outside of the bags
- Multiple sample bags are placed in large rice bags and sealed with wire. The rice bags are stored in the shed which is generally not locked but the remote location and 24 hr security guards provide a measure of sample security.
- Chain of custody is maintained in the form of commercial shipping documents
- Coarse reject samples are placed on pallets, covered in plastic, and stored in the camp yard, while sample pulps are boxed and stored at the camp or at the laboratory.

Pincock, Allen and Holt concluded that these procedures were being performed with diligence, care and were industry standard for advanced exploration projects such as El Quevar.

Pincock, Allen and Holt personnel spent four days reviewing core from 12 drill holes including the core logging, sampling and assaying procedures and the general exploration, drilling, QA/QC and underground exploration development. By visual comparison of the core with the corresponding log sheets and assays, Pincock, Allen and Holt verified that the logging and sample intervals had been correctly recorded.

During the site visit, a validation of several hole collar positions was undertaken by Pincock, Allen and Holt using GPS. Many hole collars had been obliterated due to the

Company's site reclamation activities. Drill collar locations were checked by comparison of collar locations with digital topography of the Project area. Pincock, Allen and Holt observed that the collar elevations for approximately 12 drill holes were inconsistent with the current digital topography. Golden Minerals then provided updated collar elevation information for these holes.

Pincock, Allen and Holt reviewed 78 drill holes, approximately 29% of the drill holes in the February 9, 2012 database and checked the database assays against laboratory certificates. Pincock, Allen and Holt identified several inconsistencies in the assay database for which the corresponding corrective actions were taken. General findings were:

- Field checking, original drill logs, and database were all consistent showing the appropriate angle and inclination of the drill holes completed
- Sample intervals were correct for assays entered. PAH noted only one error in the updated database caused by typographical error
- Assay certificates, drill logs and sample sheets were available for all drill holes
- Loading of assay data from laboratory certificates was correct
- During the 2011 drilling program, Golden Minerals assayed all intervals for silver by two analytical methods, ICP with reruns greater than 200 ppm Ag by the fire assay-gravimetric method (50 g charge) at the same laboratory (Alex Stewart)
- No issues with the conversion of the database were identified.

QA/QC data were compiled and examined with respect to two types of control samples:

- Control samples inserted by Silex Argentina into the sample stream sent to Alex Stewart
- Internal laboratory control samples assayed by Alex Stewart

Results included:

- A total of 35,910 assay determinations were compiled, of which 35,654 could be used for analysis. Approximately 256 entries (<1%) could not be used due to errors and inconsistencies with the laboratories.
- A total of 380 fine blanks and 1,283 coarse blanks were analyzed to test for cross-contamination from sample to sample during crushing and pulp separation. Of the 380 fine blanks assayed, only one sample was above 1 ppm Ag. Of the 1,283 coarse blanks assayed, 23 were above 1 ppm Ag. The results from the blank sample analysis indicated there was no contamination during the sample preparation stage

- Duplicate submission included 2,816 fine duplicate pairs, 1,424 coarse duplicate pairs, and 673 field duplicate pairs. A graphical check showed good correlation between original and duplicate samples analyzed for silver with the correlation coefficient R2 -values ranging from 0.8756 to 0.9849. The three types of duplicate sample analyses that were routinely submitted by Silex showed acceptable levels of variance
- Silex Argentina SRM G997-5 was the only standard to stay within ±10% of the accepted value, based on graphical analysis. The SRM graphs, exemplified by the graph for SRM STD-6, show anomalous spikes perhaps due to laboratory errors or mislabeling. Pincock, Allen and Holt noted that if one ignores the five outlier points, the graph of STD-6 also displays good accuracy and precision over a long time period
- Review of the blank sample results does not indicate signs of sample cross-contamination during sample preparation
- Analysis of duplicates and SRMs suggest that silver assays are reasonably accurate and precise.

The analysis of blanks, duplicates and standard reference materials submitted by Silex to the laboratories was considered by Pincock, Allen and Holt to provide positive indications that assay results from 2006 to 2011 were reliable and suitable for use in resource estimation.

Pincock, Allen and Holt commented on a gap in Silex's submission of SRMs to the laboratories between approximately December 2009 and December 2011. Lacking Silex's SRM analyses, instead PAH reviewed the internal control sample results reported by Alex Stewart to assess QA/QC.

Pincock, Allen and Holt found that Alex Stewart was not inserting high-grade silver standards in the sample stream going to the fire assay-gravimetric analysis. Approximately 9% of the samples (~1,100) assayed were >200 ppm Ag, and did not have corresponding standards analyzed by fire assay gravimetric methods:

- The high-grade silver SRM 999-3 has an accepted value of 291 ppm Ag (±16). When inserted into the sample stream its analysis would be reported in the ICP field as ">200 ppm", with no value reported in the fire assay-gravimetric data field
- An insufficient quantity of high-grade silver SRMs were inserted, knowing the previous samples assayed originated from a high-grade silver deposit. For example, SRM G 397-8 has an accepted silver value of 410 ppm and only four standards were inserted into the sample stream. The low to high-grade silver SRMs chosen for graphical representation all fell within their respective ±1 standard deviation.

Pincock, Allen and Holt therefore requested that an independent, blind check sample program be undertaken to confirm the accuracy and precision of silver analyses on high-grade samples greater than 200 ppm Ag for the period December 2009 to August 2011.

A total of 152 high-grade silver pulp samples were retrieved from storage in Argentina and forwarded to Minerals Exploration Geochemistry (Reno) where the pulps were dried, blended and repackaged with new sample numbers. Three high-grade certified standards were inserted in the renumbered sample stream. Minerals Exploration Geochemistry forwarded 170 blinded splits to Alex Stewart and American Assay Laboratories in Reno. The high-grade check samples ranged from 200 to 9,500 ppm Ag, averaging 1,185 ppm with a median value of 642 ppm Ag. The samples were rerun for silver at the laboratories by fire assay-gravimetric on 25 g assay charges, necessitated by the shortage of material for some samples. The list of check samples with original analyses was kept confidential until the program was completed.

Of the 152 pulps, only 151 were re-assayed by American Assay Laboratory and compared to the original samples assayed by Alex Stewart. A graphical check displayed an acceptable correlation between the original assay value and the re-assay value from American Assay Laboratory, with an R2 value of 0.9205.

Pincock, Allen and Holt requested that Minerals Exploration Geochemistry insert three high-grade SRMs into the sample stream. SRM CU112 had one sample that fell just below two standard deviations of the 358.9 ppm accepted silver value and the other two SRMs fell within ±10% of the accepted value. The two internal SRMs, CU154 and OXQ75, inserted by American Assay Laboratory also fell within satisfactory upper and lower accepted ranges. In addition to the SRMs, American Assay Laboratory conducted 16 repeats of samples, and analysis of these samples revealed an R2 value of 0.9994.

A total of 170 high-grade samples were re-assayed by Alex Stewart and were compared to their original samples assayed. A graphical check of the original sample results with the re-assay sample results was undertaken, showing a good correlation with an R2 value of 0.9249.

Three internal SRMs were inserted by Alex Stewart, and three by Minerals Exploration Geochemistry. All SRMs were within ±10% of their respective accepted values. Two of the three internal SRMs inserted by Alex Stewart also fell within ±10% of their respective accepted values. SRM 305-3 showed one sample falling below 10%. Alex Stewart assayed 18 duplicate pairs, and analysis of these samples revealed an R2 value of 0.9944.

Following the site visit and database reviews, Pincock, Allen and Holt concluded that:

"The audit of Golden Minerals' data collection procedures and resultant database by PAH has resulted in a digital database that is supported by verified certified assay certificates, original drill logs and sample books. PAH has confidence that the silver assays used in the Mineral Resource Estimate are consistent with information in drill logs and sample books. A comparison of the assay certificates and drill hole logs show consistency for the 2009-2011 drill holes. PAH believes there is sufficient data to enable their use in a Mineral Resource estimate and resultant classification following NI 43-101".

"The un-sampled zones within the host rocks appear to be significant to the deposit, comprising zones of barren overburden or inter-burden. As a result, PAH believes these zones should be classified as internal waste zones in any resource calculation".

"Based on data supplied by Golden Minerals, PAH believes that the analytical data has sufficient accuracy for use in resource estimation for the Yaxtché deposit".

12.6 Wood (2018)

Wood was provided electronic data files (Excel or csv format) for the density and geotechnical data. Using these files, updated tables for density and geotechnical information were constructed, and reviewed.

Wood was provided with assay files (Excel or csv format) directly from the Alex Stewart, ALS, Acme (now Bureau Veritas) and SGS laboratories. Based on these data, an updated assay database was constructed. The assays from the laboratories were merged with the existing assay table based on sample ID to create an updated assay table. The hole, ID, from and to intervals from the existing assay table were retained. Assays in the original table were replaced with assay data provided by the laboratories. The assay tables were reviewed.

During the site visit, Wood selected 11 witness sample intervals, quartered the half core, and shipped the samples to the Alex Stewart laboratory in Mendoza Argentina. The silver assays recorded in the database were then compared to the silver assays received from the laboratory. The assays correlated within expected variances except for one assay pair where the high variance was attributed to difficulties in sampling the irregular patches of visible silver sulphides.

The remaining database tables were provided by Golden Minerals.

Wood audited the database used to support the estimation of Mineral Resources. Collar survey, downhole survey, assays, density, lithology and redox tables were audited. The records contained in the database were compared to original logs for 21 (approximately 10%) of the drill holes contained in the database.

Collar records were only available for QVD-001 through QVD-191. Subsequent drill holes were surveyed using a total station instrument. Efforts should be made to locate the original total station survey records for the later drill holes, and ensure these are appropriately filed. During the site visit, Wood compared the location of 11 collars in the field using the Golden Minerals' hand-held GPS and found the coordinates to agree with those in the database. An additional 28 collar checks using an Wood GPS are being evaluated, but results were not available at the Report filing date.

The audit of the down hole survey data revealed a number of differences between the database and the original records. This appears to be prevalent in the early drill holes, and may reflect some drilling that has had magnetic declination applied.

The comparison of assay data to the original certificates found five samples with errors to the silver assays. This issue is not considered material, and the data have been corrected in the database.

The audit of the density data revealed only occasional errors in the data entry.

During the site visit, Wood collected eight samples that that were measured for specific gravity (SG) using un-waxed volumetric method by on-site Gold Minerals personnel. These samples were sent to Alex Stewart for re-analysis using both the waxed and unwaxed SG methods. Results showed little difference between the on-site unwaxed measurements and the waxed measurements from the laboratory.

The audit of the lithology data was difficult due to a 2012 relogging campaign. Only a few logs matched with the codes contained in the database.

It appears the redox data was revised in 2008, 2010, and again in 2012. As such, very few holes matched the database. In cases were the holes did not match, it was not possible to determine if the correct version of the drill hole log had been located. The redox codes were re-evaluated for the resource model by comparing the redox codes in the database to the drill core photos, and adjacent drill holes. These data were then used to construct a digital terrain model (DTM) that was used to categorize oxide and sulphide in the resource model. Material logged as mixed was included with the oxide, and not included in the sulphide resource model.

Golden Minerals is currently compiling the historical QA/QC data into the Project database. Once the compilation is completed, Wood recommends a review of the results to validate the compilation. Validation should include checks for data entry errors, and checks to ensure all of the QA/QC data examined during the 2012 Pincock Allen and Holt review have been captured.

12.7 Comments on Section 12

Data verification completed by external consultants in the period 2009–2012 indicated the data at the time was suitable to support Mineral Resource estimates.

Wood audited collar survey, downhole survey, assays, density, lithology and redox tables. The data are considered acceptable to support Mineral Resource estimates.

Wood recommends that Golden Minerals annotates the existing database in support of auditability. This should include documentation of which drill holes have had magnetic declination applied, and a record of where changes to original logging codes have been made as a result of the completed re-logging and redox re-coding campaigns.

13.0 MINERAL PROCESSING AND METALLURGICAL TESTING

13.1 Introduction

The Yaxtché deposit consists of silver mineralization developed within host volcanic (and locally intrusive) rocks in east to west-trending structurally-controlled mineralized breccia structures at relatively shallow depth in the eastern portions of the deposit and at greater depth in the western portion. Important differences in mineralogy may occur at lower and upper levels in the succession of mineralization influenced by alteration in the upper domains around the perimeter of the main mineralized east–west-trending structures. This results in the shallower east zone where the structures outcrop in a developed oxide domain overlying mixed supergene and sulphide mineralization domains progressing to depth. The mineralization in the mineralized structures plunging to depth in the central and west zones are dominantly sulphides.

A large number of minerals have been reported at Yaxtché, many of which are fine grained sulphosalts of minerals that are hard to identify. The principal mineralization is silver with lesser amounts of lead, zinc and copper minerals. Accessory antimony, arsenic and bismuth minerals represent potential concentrate impurity sources. The principle gangue minerals are quartz, pyrite and barite.

Golden Minerals commissioned Dawson Metallurgical Laboratories, Inc. of Salt Lake City, Utah, to complete testwork on relevant sample composites from the from Yaxtché deposit. The tests were intended to determine the response the samples to whole-ore cyanidation, sulphide flotation, and a combination of flotation and cyanide leaching of tailings.

Initial tests between 2008 and early 2010 on samples of mineralized core from the east, central and west zones were intended to determine the response the samples to whole-ore cyanidation, flotation, and a combination of flotation and cyanide leaching of tailings. Testwork was conducted on samples of oxide, mixed supergene and deeper sulphide mineral resources considering both potential open pit and underground mining options.

Subsequent to refining of the mineralization controls and a focus on the underground portion of the deposit, testing from 2010 onwards concentrated on sulphide mineralization. The Mineral Resources estimated in this Report are based on an underground mining scenario and associated sulphide material; however, testwork prior to 2010 including oxide material is described in the following summary of results for completeness.

13.2 Metallurgical Testwork

Table 13-1 summarizes the testwork programs conducted to date on samples from Yaxtché.

Table 13-1: Testwork Programs

Date	Program
July 2008	Preliminary cyanidation (whole-ore and float tails) and flotation testing on six composite samples (oxide, mixed, and sulphide) of core
January 2009	Continuing cyanidation and flotation testing on five composite samples (master, east, west, central and sulphide only) of core
January 2010	Continuing cyanidation of mill feed material (and float and tail products) and flotation testing on four composite samples (each 14–18 kg for west, central, east and master) of core
March 2010	Continuing selective Cu/Ag and cyanidation of float tails testwork on Jan 2010 Master Composite sample
June 2010	Memorandum for the testwork on Jan 2010 West Composite sample material received March 15
February 2011	Initial flotation and cyanidation (and POX on mill feed material) testing on new YWMC-2010 west Master Composite (including blended Oct 4 underground adit west stoping areas F, G, H, and I, and March 15 samples
October 2012	Continuing flotation and cyanidation testing on YWMC-2010 composite and flotation of a bulk sample (received May 2012)

13.2.1 2008

Forty-five individual Yaxtché deposit mineralized core samples from drill holes QVD-018 through QVD-022, and QVD024 were composited into six composites for the metallurgical test program.

The composites were crushed to 10 Tyler mesh size, and split into 1 kg charges. One charge from each composite was then split into four 250 g samples with two of the splits pulverized and submitted for head analysis. The composites were classified by degree of oxidation, and by grade (Table 13-2).

All tests were performed at a fine primary grind of approximately 80% passing 74 µm. No attempt was made to optimize either the cyanidation or flotation parameters.

The following procedures were used:

- Whole-ore cyanidation
- Selective silver flotation followed by bulk sulphide pyrite flotation of the silver tailings. A sequential silver–lead, zinc, and pyrite flotation scheme was evaluated on a high-grade sulphide sample containing significant amounts of silver, lead, and zinc
- Cyanidation of the pyrite flotation tailings

The oxide samples generally responded well to whole-ore cyanidation and the sulphide samples better to flotation.

Table 13-2: 2008 Composites for Metallurgical Testing

Type	Grade	Ag ppm	Au ppm	Pb %	Pbns %	Zn %	Znns %	Fe %	Bi %	As %	Sb %	Cu %	Stot %	Ssulph %	Sns %
Oxide	low	58	<0.17	0.41	0.02	0.023	0.0019	3.25	0.008	0.17	0.061	0.013	3.64	0.751	2.89
Mixed Ox-Sul	medium	251	<0.17	0.15	0.00	0.004	0.0019	2.18	0.082	.08	0.095	0.048	4.37	0.761	3.61
	high	2,020	0.27	1.02	0.12	0.022	0.002	4.16	0.086	0.37	0.302	0.016	3.24	1.04	2.20
Sulphide	low	72	<0.17	0.11	0.00	0.022	0.0018	4.83	0.022	0.04	0.042	0.07	7.50	0.376	7.12
	medium	193	0.17	0.28	0.03	0.097	0.002	4.06	0.043	0.05	0.8	0.136	6.28	0.498	5.78
	high	832	0.58	1.60	0.18	1.70	0.0283	12.50	0.184	0.21	0.396	0.822	17.20	0.6	16.60

Note: tot, ns, sulph refer to total, sulphide, and non-sulphide, respectively

Overall the samples generally responded well to a combination of sulphide flotation (silver followed by pyrite) and cyanidation of flotation tailings. It was noted however that in the sulphide composites a significant portion of the recovered silver (about 60%) and zinc reported to the pyrite concentrate and not the selective silver concentrate. The very low-grade pyrite concentrate produced would be difficult to market and additional testwork would be required to investigate methods of recovering the silver from this product. The silver concentrates produced from the low-grade to high-grade sulphide composites tested contained elevated arsenic (1,780 to >10,000 ppm), antimony (2,310 to >10,000 ppm) and bismuth (859 to > 10,000 ppm) values.

The high-grade sulphide concentrate was subjected to selective Ag–Pb flotation followed by zinc flotation, and indicated a selective silver–lead and zinc flotation scheme is possible with this material. It was noted about 51% of the silver and lead and 44% of the copper reported to a silver concentrate and 83% of the zinc in the mineralized material reported to a zinc rougher concentrate. However, recoveries of lead (40%), copper (47%) and silver (32%) were still relatively high to the zinc concentrate, and additional testwork was recommended to increase recovery of these to a silver concentrate and improve overall metal revenues.

Whole-ore cyanidation results yielded lower silver extractions than the leaching of flotation concentrates and tails. Generally, the sulphide samples indicated the lowest recovery, possibly due to the presence of silver sulphosalts. Cyanide consumptions for the whole-ore leach tests varied from 1.4 to 10.4 kg/t depending upon the sample tested, when 5 g/L NaCN leach solution strength was used. Leach kinetic curves indicated that almost all the leachable silver was extracted in 48 hours. The testwork results are summarized in Table 13-3.

Table 13-3: Summary of 2008 Test Results

Composite	Ag recovered % from mill feed material				Head Assay **	
	Flotation	Float Tails Leach	Total*	Whole-Ore Leach	Ag (opt)	S= wt%
Low Grade Oxide	36.2	27.2	63.4	53.0	65.0	2.81
Medium Grade	74.5	15.2	89.7	83.0	314.0	3.48
Mixed High Grade	78.1	11.6	89.7	83.4	1785.0	2.30
Sulphide Low Grade	79.1	11.8	90.9	44.2	80.0	6.58
Sulphide Medium Grade	88.l	8.4	96.5	56.9	189.0	6.15

Note: *Flotation + Flotation Tails Leach **Head assay back-calculated from flotation tests

Based on the metallurgical test results, Dawson (2008) envisioned a flowsheet for a future process plant for treating both oxides and sulphides with the following processes:

- Primary crushing
- Semi-autogenous grind (SAG) and ball mill grinding with a vibrating screen and cyclones for size classification
- Rougher and cleaner flotation with regrind for the production of a final sulphide silver concentrate. Possible production of a separate zinc concentrate
- Thickening, filtering, and packaging for shipment of final sulphide silver and zinc concentrates
- Leaching (cyanide) of the flotation tailings
- Counter-current decantation circuit with thickeners producing a silver-bearing pregnant leach solution (PLS)
- Merrill-Crowe circuit for processing the PLS solution producing a doré for shipment to an off-site refinery
- Cyanide destruction circuit
- Disposal of final plant tailings.

13.2.2 2009

Five metallurgical composites were tested by Dawson during November and December of 2009 for their response to various sequential processing steps to determine the overall recovery of silver from the mineralized material of relevant zones. The processes tested on each composite comprised the following.

- Cyanide leaching of whole composites
- Flotation of the sulphides followed by cyanide leaching of the floated sulphides, plus cyanide leaching of the flotation tails

- Flotation (without leaching) of the sulphides, followed by cyanide leaching of the flotation tails.

Table 13-4 presents the head grade assays for the composites used in the 2009 testwork.

Figure 13-1 shows the results of the whole-ore leach, Figure 13-2 shows the silver recovery from the flotation concentrate leach plus tails leach, and Figure 13-3 shows the silver recovery from flotation concentrate plus tails leach.

The tests showed that the various types of mineralization in the deposit were amenable to silver recovery by a combination of flotation and cyanide leaching of the flotation tails. Sulphide sample were less amenable to whole-ore cyanidation compared to flotation, especially the eastern composite sample.

13.2.3 2010

Laboratory testwork was performed to investigate silver recovery by a combination of flotation and cyanidation of mineralized material and flotation products from three new samples of mill feed material from the Project. The previous work performed on El Quevar samples had indicated good silver recovery by flotation (+90%), but not by whole-ore cyanidation (±60%). Attempts to increase silver extraction by ultra fine grinding of float concentrate and two-stage, high cyanide leaching gave a 72% Ag overall extraction with extremely high cyanide consumption.

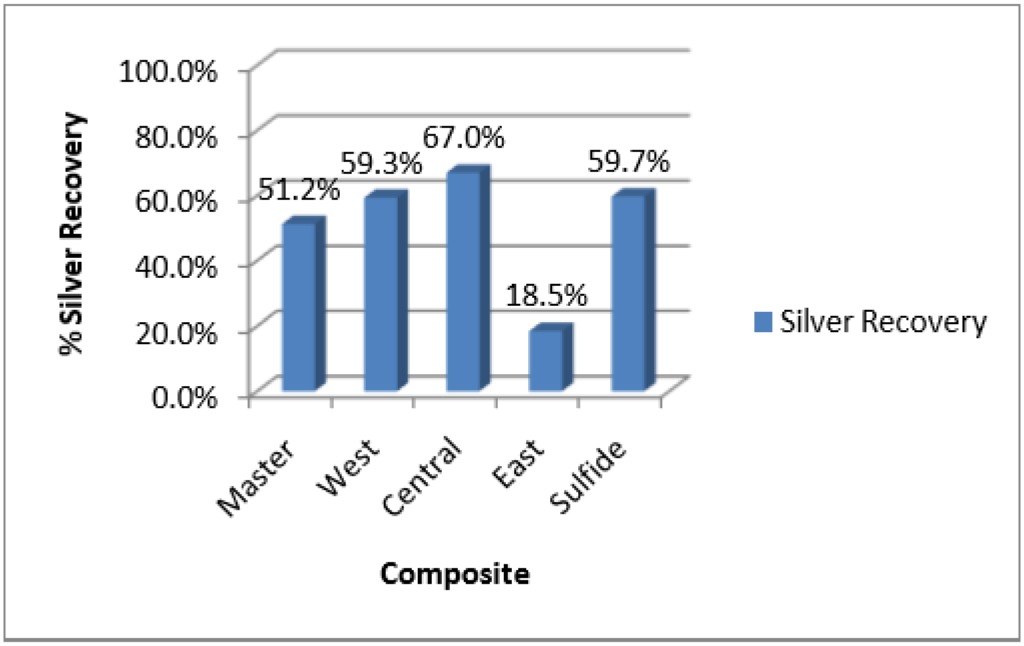
A grind fineness of 80% minus 325 mesh was selected for the 2010 work. The leach cyanide concentration was determined according to the copper content of each mill feed material sample, to limit cyanide consumption. The NaCN concentration was added at a CN:Cu ratio of 4.0, to supply sufficient cyanide for copper complexing, with only another 2 g/L NaCN added in excess. The following tests were performed:

- Whole-ore cyanide leach with assay screen analysis of the leach residue
- Bulk sulphide flotation with assay screen analysis of the rougher tailings
- Cyanide leach of reground float concentrate with assay screen analysis of the leach residue
- Cyanide leach of rougher tailings with assay screen analysis of the leach residue.
- Selective flotation for silver recovery
- Gravity concentration of ground mineralized material for free silver determination.

Table 13-4: Head Grade Assays from Composites used in 2009 Testwork

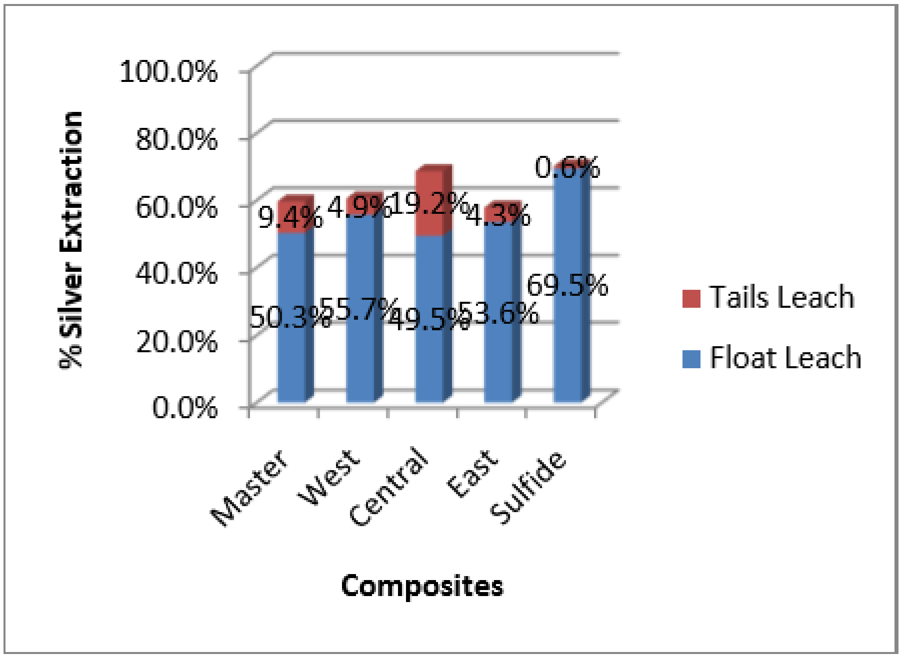
Composite	Master	West	Central	East	Sulphide
Head Grade Ag (g/t)	544	575	335	680	529

Figure 13-1: Silver Extraction, Whole-Ore Leach



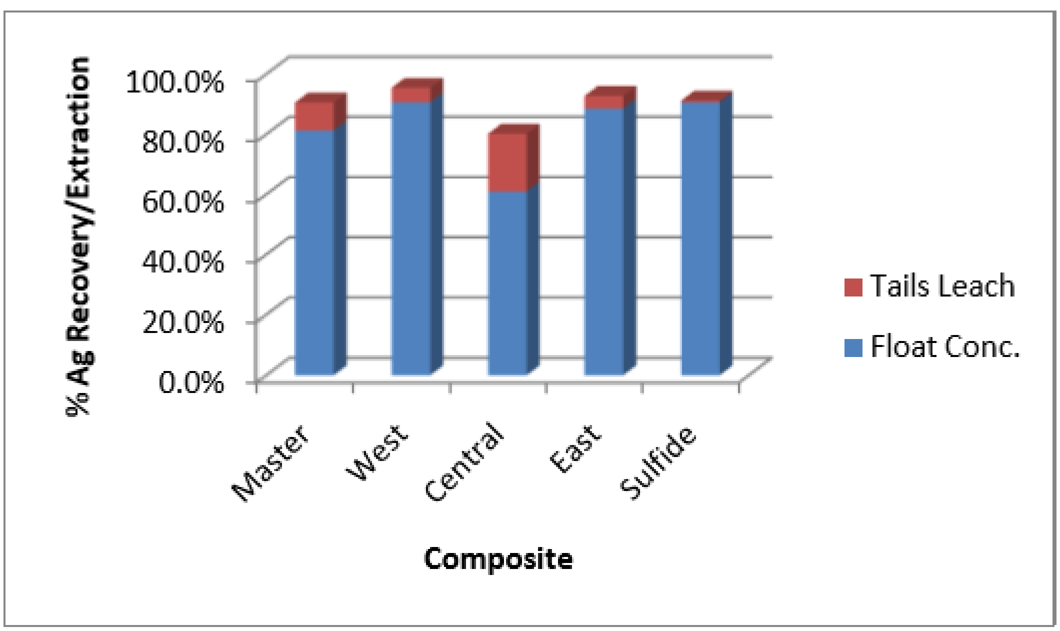
Note: Figure from Dawson, 2009.

Figure 13-2: Silver Recovery Flotation Concentrate Leach Plus Tails Leach



Note: Figure from Dawson, 2009.

Figure 13-3: Silver Recovery from Flotation Concentrate Plus Tails Leach



The first four tests were performed on each of the three samples and on an equal weight master composite (MC). The last two tests were performed only on the master composite.

A total of 116 samples were received for testing, 65 of which were used to make up the three composites. The samples were each blended, and 1.0 kg charges were split out for the testwork using a rotary splitter. Six charges of each of the three composites were combined to produce an 18 kg MC. Head samples were sub-split, pulverized, and submitted for analysis. Table 13-5 summarizes the head grades.

The mineralized material was treated by a combination of cyanide and flotation test procedures at a grind of 80% minus 45 µm. About 51% of the silver was leached from the master composite utilizing a whole-ore leach, whereas 81% was recovered by bulk sulphide flotation. The float concentrate was reground and leached, and the flotation tails leached separately, for a combined float/leach recovery of 60%. A total of 90% recovery was obtained from the combined bulk float concentrate plus leaching of the rougher tailings.

Very high cyanide consumption was noted for the cyanide leach of the master and east composites due mainly to the presence of copper in the mineralized material. Cyanide consumption of about 14 kg/t and 41 kg/t of mineralized material was determined for the two samples, respectively, and 1–2 kg/t for the other two samples, for the combined regrind concentrate and tailings leaches. The consumption was about the same as for the whole-ore leaches (the East composite was slightly less due to insufficient NaCN), even though the silver and copper extraction was significantly greater.

Table 13-6 summarizes the flotation and leach silver recovery.

Testwork continued on the MC sample to investigate the effect of variations in the test procedure on overall silver recovery.

The baseline procedure consisted of selective flotation of a silver/copper concentrate at ambient pH, followed by cyanide leaching of the flotation tailings. An assay screen analysis was determined on both the rougher tailings and the leach residue. The reagents selected for the selective float were a dithiophosphinate (Aerophine 3418A) and a dithiophosphate (Aerofloat 242). The procedure included:

- Selective flotation at grind fineness of P80 = 45 and 75 µm, using one or two rougher stages
  - A float test was run with reduced reagent (Aerophine only).
  - A float test was run including bulk sulphide recovery.
  - A float test was conducted at 12 pH with lime addition
- Rougher tailings of the above tests were leached with 2 g/L NaCN solution

Table 13-5: Head Grades, 2010 Composites

Composite	Head Grades									
	ppm		Weight %							
	Au	Ag	Cu	Fe	Pb	Zn	S=	As	Bi	Sb
Master	0.185	517	0.41	4.24	0.46	0.16	4.02	0.15	0.1	0.15
West Zone	<0.001	529	0.11	5.07	0.25	0.02	5.35	0.07	0.04	
Central Zone	0.008	313	0.03	2.64	0.9	0.35	2.13	0.06	0.05	
East Zone	0.218	658	1.02	4.7	0.22	0.09	4.89	0.28	0.22	

Table 13-6: Summary of Flotation and Leach Silver Recovery

Composite	Whole-Ore Leach - % Extraction	Float Recovery %	Leach Extraction - %		Overall Ag Recovery - %	
			Conc. Leach	Ro Tails Leach	Float Con. Tails & Leach	Float Con. Tails & Leach
Master	51.2	81.2	61.9	49.8	90.6	59.6
West	59.3	90.6	61.5	52.1	95.5	60.6
Central	66.8	61	81.1	49.2	80.2	68.7
East	18.1	88.5	60.6	37.4	92.8	57.9

Note: Table adapted from the January, 2010, Dawson metallurgical report.

- Assay screen analysis of rougher tails of the above tests was performed (except T34)
- Assay screen analysis of leach residue of the above tests was performed
- A selective float test was run followed by cleaner flotation.

Silver flotation recovery ranged from 56 to 86% depending on the test conditions. Subsequent leaching of the flotation tailings resulted in an overall silver recovery (combined float concentrate, plus leach solution) ranging from 82 to 91% (Table 13-7). Cyanide consumption was relatively low, averaging 1.0 kg/t, since most of the copper was removed into the float concentrate, which was not leached. An average of 7% of the copper reported to the leach solution, for 220 ppm copper solution average.

A small testwork program was undertaken on a sample from Yaxtché West. The sample head grade is provided in Table 13-8.

Table 13-7: Summary of Float/Tails Leach Tests

Test Number	Grind P80 µm	Number of Ro Stages	Float Conditions	Silver Distribution - % Flot Con	Silver Leach Solution	Silver Leach Residue	Silver Total Con + Soln	Copper Distribution - % Flot Con	Copper Leach Solution	Copper Leach Residue	Copper Total Con + Soln
21, 27	45	1	Baseline	58.4	26.2	15.4	84.6	83.7	8.9	7.3	92.7
22, 28	45	2	Extended Time	76.6	11.8	11.5	88.5	90.9	5.3	3.8	96.2
23, 29	75	1	Coarser Grind	55.6	26.9	17.58	82.5	79	11	10	90
24, 30	75	2	Coarse Grind+Time	73.3	13.7	13.1	86.9	86.8	6.7	6.6	93.4
25, 31	75	4	Bulk Sulphide	80.9	9.7	9.4	90.6	88	6	6	94
26A, 32A	45	3	12 pH	85.5	5.7	8.8	91.2	95.4	1.4	3.2	96.8
34, 35	45	1	Decreased Reagent	57.4	24.6	18	82	80.3	10.7	8.9	91.1

Note: Table adapted from the March, 2010, Dawson metallurgical report.

Table 13-8: Head Grade Analysis, Yaxtché West Composite

Composite	Head Grades g/t Ag	Weight % Cu	As	Bi	Sb
West Composite	2,900	0.27	0.04	0.08	0.32

Overall silver recovery, using the procedure developed for the central composite (flotation concentrate for sale, with leaching of the flotation tails to produce bullion for sale) was 98.6%. This was from the production of a cleaner concentrate at 5.5% of the feed weight, followed by a 24 hour leach of the tails and of the cleaner tails.

The metallurgical response of the two composites was significantly different. For the central composite, 58.4% of the silver was recovered into a high-grade flotation concentrate, with an additional 25.3% recovered in the leach of the flotation tails, for an overall 84% silver recovery. For the west composite, 97.3% of the silver was recovered into the flotation concentrate, with an additional 1.3% recovered in the tails leach, for an overall 99% recovery.

The difference in response may be due to differences in the silver mineralogy between the two areas. In the central composite it was possible to make a selective initial flotation concentrate using a limited amount of copper mineral-selective collector (recovery of 86% of the copper but only 55% of the silver). Increasing amounts of collector in subsequent stages increased the silver recovery significantly and the copper recovery marginally. It is advantageous economically to recover as much of the silver as possible in to bullion, since higher treatment charges for flotation concentrate may be incurred, due primarily to the presence of arsenic, antimony and bismuth.

Increasing collector dosage in subsequent flotation stages for the Yaxtché West composite, up to and including a bulk concentrate, floated more weight but with little significant improvement in overall silver recovery.

The microscopy work done by Prof. Erich Petersen on the central composite flotation products did not show significant differences in the silver mineralogy between the initial and subsequent flotation concentrates, but his report does discuss possible reasons for a slower-floating fraction. Further testwork was recommended on the Yaxtché West composite to determine if it would be possible to reject some silver minerals from the initial flotation concentrate to be recovered by leaching of the tails, as with the central composite; but based on the results shown, this seems unlikely.

Cleaning the high-grade rougher concentrate for both composites resulted in the rejection of a large amount of gangue material, with a resultant 50% reduction in concentrate weight and a corresponding increase in the assays of smelter penalty elements. For the Yaxtché West composite the cleaner flotation tails were leached, and much of the silver here was recovered. Because of insufficient sample, the cleaner tails from the central cleaner test were not leached.

Testwork at both 45 µm and 75 µm grinds was evaluated, and although the difference is small, preliminary calculations indicated that the finer grind would be economically warranted.

13.2.4 2011

A total of 129 nine individual samples with a total weight of about 130 kg sampled from stopes (F, G, H and I) in a new underground exploration adit developed in the west zone of Yaxtché were received. A new blended-grade composite designated YWMC-2010 (Yaxtché West master composite) was created using these samples and previous similar west composite samples. Testwork was performed on this composite following the flotation and cyanide leach procedures used in the previous work. Previous work recommended further testwork on the Yaxtché West composite to determine if it would be possible to reject some silver minerals from the initial flotation concentrate to be recovered by leaching of the tails, as with the central composite. In addition, due to the presence of high levels of deleterious elements in flotation concentrate in previous work, as an alternative flowsheet it was also recommended investigating the pre-treatment of the mineralized material using pressure oxidation to try and improve the low direct-cyanidation recoveries. The following testwork was performed on mill feed material ground to 80% minus 45 µm:

- Selective rougher flotation with cleaner to obtain a high-grade silver concentrate

- Selective flotation followed by bulk sulphide flotation to scavenge sulphides and assess potential to increase silver recovery.
- Cyanide leach of whole-ore and flotation tailings
- Cyanide leach of bulk concentrate and whole-ore after pre-treatment by autoclave pressure oxidation.

Table 13-9 summarizes the head grade of the new YWMC-2010 composite. Table 13-10 summarizes the flotation results from the new YWMC-2010 composite.

Results of flotation testing indicated rougher silver recovery of about 92% to 95% with about 6.5 wt% to 10.5 wt% concentrate weight pull and copper recovery of about 92% were obtained from the YWMC-2010 composite using selective flotation procedures. However, due to the mineralogy of the mineralized material, potentially deleterious concentrate penalty elements also reported to the concentrate. Increasing the float with bulk flotation did not significantly increase the overall silver recovery. Final cleaned concentrate grades of 4.8% Cu and 21,200 g/t Ag grades were obtained in a single cleaning stage, compared to 7.5% Pb+Zn, 0.6% As, 3.6% Sb, and 1.2% Bi, into a 2.9 wt% concentrate with 84% silver and 81% copper recovery.

Cyanide leaching of whole-ore and flotation tailings for silver recovery was investigated. Less than 40% of the silver was recovered by cyanide leaching of whole-ore. About 50% of the silver present in flotation tailings was extracted by leaching in 48 h with a relatively low cyanide consumption of about 0.5 kg/t. However, this only accounts for 2–4% in the mineralized material, since most of it was already recovered in the flotation concentrate.

Pre-treatment of whole-ore and bulk flotation concentrate was performed to improve silver recovery by subsequent cyanide leaching. The samples were autoclaved using pressure oxidation to destroy sulphides, followed by hot lime treatment to destroy jarosites, both of which prevent silver extraction. However, results indicated the pre-treatment steps were not sufficiently effective in increasing silver extraction.

In the case of whole-ore, the kinetics for silver extraction were very rapid and recovery improved to about 60% after POX, from 37%, but recovery was still limiting.

However, in the case of the bulk concentrate, only about 40% silver was recovered in cyanide leaching after POX. About 91% of copper was however extracted to the acid autoclave solution.

Table 13-9: Head Grade Analysis, YWMC-2010 Composite

Composite	ppm		Assay (wt %)							
	Au	Ag	Cu	Fe	Pb	Zn	S=	As	Bi	Sb
WYMC2010 assay	0.022	745	0.17	3.55	0.32	0.12	3.50	0.037	0.049	0.14
Back-calc *	0.036	743	0.18	3.43	0.33	0.10	3.89	0.029	0.050	0.15

* back calc average from T43–56, T62–63 for Ag, Cu, Fe, Pb, Bi, Sb; T53–56 for Au, Zn, S=, As. Based on head analysis of samples received October 4, 2010.

Table 13-10: Batch Flotation Results 2011, YWMC-2010 Composite

Test Product	Wt%	Concentrate Assay											Distribution (%)	
		ppm		Percent										
		Ag	Au	Cu	Fe	Pb	Zn	S=	As	Bi	Sb	Insol	Ag	Cu
Cleaner con	2.92	21,200	0.104	4.79	28.7	4.68	2.83	33.3	0.62	1.17	3.56	11.8	83.8	80.9
Rougher con	6.87	9,884	0.040	2.24	17.5	2.40	1.40	19.7	0.32	0.58	1.68	45.4	92.0	89.3

Note: T53: baseline selective float with 1 rougher, followed by 1 cleaner stage

The original West Yaxtché whole-ore composite, which is similar to the YWMC-2010 composite, was also given the same treatment and submitted for mineralogy. About 85% sulphide oxidation was noted after autoclave treatment. Hematite that precipitated in the autoclave may also have encapsulated some silver, which would not be released during the jarosite conversion step. Rimming of alunite by jarosite, which was noted, would also possibly limit the effectiveness of hot lime treatment to destroy jarosite with the amount of lime added in the test. The combination of these three factors means the recovery of silver may be near to the limit for this sample. Additional work was recommended at higher lime levels to assess if this was limiting, and determine if silver recovery could be increased.

13.2.5 2012

This testwork phase provided previously unreported results of continued work on the blended grade composite designated YWMC-2010 (Yaxtché West master composite) from the previous phase. A second bulk sample was also sent to Dawson for additional work; however, it was determined to be significantly lower in grade than expected, and following some baseline background work, testing was suspended on this sample. Testing that was performed on the YWMC-2010 sample ground to 80% minus 45 µm included:

- Selective rougher flotation with two stages of batch cleaning, to try and obtain a higher grade of concentrate than obtained previously with one stage

- Repeat selective batch rougher and two cleaner stage of cleaning including a cleaner scavenger to define conditions for a subsequent locked cycle test
- A locked cycle flotation test using two cleaner stages, with no rougher concentrate regrind
- A second stage of lime treatment prior to cyanide leach of rougher flotation concentrate which had already been given POX + Hot lime treatment
- A second stage of lime treatment prior to cyanide leach of whole-ore which had already been given POX + hot lime treatment.

Primary grind sensitivity and batch rougher cleaner flotation tests with and without rougher concentrate regrind were also conducted on the YWMC composite and other previous samples.

Table 13-11 summarizes the 2012 reported batch flotation results with the YWMC-2010 composite relative to the baseline 2011 test result with only one stage of cleaning. Table 13-12 summarizes the flotation locked cycle tests performed.

The results of the batch and locked cycle flotation on the composite indicated 93% Ag could be recovered to a 6.4 wt% weight pull concentrate with a 10,600 g/t Ag grade. The cleaner test was performed without regrind of the rougher concentrate. Tests indicated that a much higher silver grade could be obtained with regrind. However, the relatively high content of arsenic, antimony and bismuth in the concentrate remains a marketing concern.

Table 13-13 summarizes the results of a primary grind sensitivity on the composite with and without concentrate regrind using a single cleaner stage.

The results indicated an average silver recovery to the combined cleaner concentrate plus scavenger cleaner concentrate increased from 85.2% to 88.5% as the primary grind P80 fineness increased from 106 to 75 µm. Recovery did not increase with further grinding. The first cleaner concentrate grade averaged 500 g/t Ag when the rougher concentrate was not re-ground, and 750 g/t Ag when it was re-ground to a target of 45 µm. However, this compared with 10,000 g/t Ag for the WYMC-2010 mill feed material composite. About 15 wt% of the mineralized material weight reported to the rougher stage, reduced to 9.5 wt% with one stage of cleaning.

Table 13-11: Batch Flotation Results 2012, YWMC-2010 Composite

Test	Test Product	Wt %	Concentrate Assay											Distribution %	
			g/t		percent										
			Ag	Au	Cu	Fe	S=	Pb	Zn	As	Sb	Bi	Insol	Ag	Cu
T64	#2 Cl Con	4.02	14600	0.005	3.60	32.9	40.0	3.62	2.40	0.58	2.39	1.04	9.35	87.9	87.6
	# 1 Ck Con	4.91	12253	0.028	3.02	29.8	36.0	3.11	2.02	0.50	2.01	0.88	16.72	90.1	90.0
	#1 and #2 Ro Con	9.47	6591	0.030	1.64	18.5	22.0	1.79	1.11	0.29	1.09	0.49	—	93.6	93.9
Test	**Test Product**	**Wt %**	**Concentrate Assay**											**Distribution %**	
			g/t		**percent**										
			Ag	**Au**	**Cu**	**Fe**	**S=**	**Pb**	**Zn**	**As**	**Sb**	**Bi**	**Insol**	**Ag**	**Cu**
T65	#2 Cl Con	5.21	12300	0.005	2.88	33.0	37.2	3.16	1.98	0.47	2.28	0.79	—	91.6	91.9
	# 1 Ck Con	6.29	10340	0.0331	2.42	29.4	33.1	2.71	1.67	0.40	1.92	0.67	—	92.9	93.3
	#1 and #2 Ro Con	11.60	5772	0.039	1.35	18.4	21.0	1.63	0.95	0.23	1.07	0.38	—	95.6	96.0
	Cl Scav Con	0.70	1450	0.105	0.33	17.8	20.1	0.69	0.42	0.11	0.26	0.13	—	1.5	1.4
Test	**Test Product**	**Wt %**	**Concentrate Assay**											**Distribution %**	
			g/t		**percent**										
			Ag	**Au**	**Cu**	**Fe**	**S=**	**Pb**	**Zn**	**As**	**Sb**	**Bi**	**Insol**	**Ag**	**Cu**
T53	Cleaner Con	2.92	21,200	0.104	4.79	28.7	33.3	4.68	2.83	0.62	3.56	1.17	11.8	83.8	80.9
	Rougher Con	6.87	9,884	0.040	2.24	17.5	199.7	2.40	1.40	0.32	1.68	0.58	45.4	92.0	89.3

Note:

T64 = baseline selective float with 2 roughers, followed by 2 cleaner stages.

T65 = repeat baseline selective float T64 with 2 cleaners and #1 cl scavenger.

T53 = baseline selective float with 1 rougher, followed by 1 cleaner stage

Table 13-12: Locked Cycle Flotation Results 2012, YWMC-2010 Composite

Product	Overall wt%	Assay Ag (g/t)	Cu (%)	Fe (%)	S (%)	Au (g/t)		% Distribution Ag	Cu	Fe	S	Au
#2 Cleaner Con	6.41	10598	2.37	35.16	39.2	0.350		93.10	92.6			
Cl Scav Tails	5.59	272	0.060	3.40	4.53	0.040		2.08	2.0			
Ro Tails	88.01	40.0	0.010	1.07	3.04	0.016		4.82	5.4			
Total Av	100	730	0.164	3.39	4.56	0.039		100.00	100.0			
Product	**Overall wt%**	**Assay Pb (%)**	**Zn (%)**	**As (%)**	**Sb (%)**	**Bi (%)**	**Insol**	**% Distribution Pb**	**Zn**	**As**	**Sb**	**Bi**
#2 Cleaner Con	6.41	2.53	1.71	0.40	1.89	0.63	11.3	52.3	90.9	77.9	80.9	85.3
Cl Scav Tails	5.59	0.32	0.04	0.02	0.07	0.030	84.6	5.7	1.9	3.4	2.6	3.5
Ro Tails	88.01	0.15	0.01	0.01	0.03	0.006	90.0	42.0	7.3	18.77	16.5	11.2
Total Av	100	0.31	0.12	0.03	0.15	0.047	84.7	100.0	100.0	100.0	100.0	100.0

Note: T66: metallurgical balance based on average of cycles 4–6.

Table 13-13: Grind Sensitivity Batch Flotation Results

Test #	Target P80 (µm) Ro Grind	Cl Regrind	Cl Con (wt%)	Cleaner Concentrate Assay g/t Ag	Au	Wt% Cu	Fe	S=	Pb	Zn	As	Sb	Bi	Insol	%Dist Cl = Scav. Con Ag	Cu
67	106	106	15.5	489	0.073	1.58	29.0	34.5	0.05	0.03	0.48	0.30	0.12	31.7	85.0	93.4
68	106	45	9.3	767	0.118	2.65	40.6	48.4	0.08	0.09	0.47	0.47	0.19	6.7	85.4	92.4
69	75	75	14.3	522	0.086	1.9	31.8	37.5	0.05	0.04	0.48	0.32	0.12	24.1	89.1	93.0
70	75	45	9.6	731	0.122	2.42	42.4	48.5	0.07	0.06	0.64	0.43	0.18	5.8	88.0	92.5
71	45	45	11.3	644	0.092	2.18	36.3	43.0	0.06	0.05	0.56	0.38	0.17	13.4	84.7	90.1

Note: selective flotation with/without regrind and 1 stage cleaning

An autoclave/hot lime leach alternative to extract the silver while excluding these impurities was investigated as recommended from the previous phase, without satisfactory results. Efforts to improve the silver recovery by including a second lime boil stage were only partly successful in this study. An overall extraction of 51% Ag was achieved for the flotation concentrate and 70% for whole-ore. The presence of hematite that could encapsulate silver and the occurrence of silver containing lead locked in quartz was also noted in a mineralogical assessment of autoclave discharge in the previous testwork phase. The recovery of silver using this process alternative still appears to be mineralogically limiting, and further mineralogical studies and testwork are required to identify the drivers limiting silver recovery and assess the potential to improve this.

Table 13-14 summarizes the head analysis of the Oct 2011 low-grade Yaxtché West bulk sample on which some preliminary work was conducted to obtain background data. The silver grade of the bulk sample (83 g/t Ag) is significantly lower than the YWMC-2010 composite (745 g/t Ag) and previous samples. A grind study on the bulk sample showed that the mineralized material was significantly harder than the earlier composites. Tests indicated that silver could be recovered from this sample using the selective flotation procedure. However, concentrate grade was low, with relatively high arsenic, antimony and bismuth content. This bulk sample apparently was extremely lower grade than anticipated, and most of the testing was not completed. However, preliminary flotation tests on this sample did indicate comparable rougher recovery at 106 and 75 µm primary grind, and it may not be necessary to grind the mineralized material to the finer size. Additional tests on mill feed material with acceptable silver grades would be needed to confirm this.

13.3 Recovery Estimates

Metallurgical investigations to date for the underground sulphide resources considered in the Mineral Resource estimate in Section 14 have evaluated the amenability of composite samples from relevant zones across the deposit to a number of alternative conceptual silver recovery flowsheets including:

- Flotation (concentrate)
- Flotation and cyanidation of flotation tailings (concentrate and doré)
- Flotation and concentrate cyanidation and flotation tailings cyanidation (doré).
- Flotation and concentrate cyanidation (POX) and flotation tailings cyanidation (doré)
- Whole-ore cyanidation (doré)
- Whole-ore cyanidation (post POX) (doré).

This work has concluded in general for sulphide mineralization:

- Whole-ore and concentrates are less amenable to direct cyanidation with relatively low silver recoveries below 50%
- The use of POX indicated these relatively cost intensive pre-treatment processing steps were not sufficiently effective to materially improve silver cyanidation recoveries. Direct-ore silver recoveries improved up to about 70% and 51% for whole-ore and concentrates respectively. This process option still appears to be mineralogically limiting and further mineralogical studies and testwork would be required to identify the drivers limiting silver recovery and assess the potential to improve this

Table 13-14: Head Analysis of the Oct 2011 Low Grade Yaxtché West Bulk Composite

Composite	ppm		Assay (wt %)							
	Au	Ag	Cu	Fe	Pb	Zn	S=	As	Bi	Sb
Bulk sample assay	0.019	83	0.27	5.39	0.02	0.01	7.46	0.081	0.021	0.06
Back-calc *	0.005	88	0.27	5.66	0.03	0.01	7.14	0.078	0.023	0.06

Note: * back calc average from T67–71. Head analysis of bulk sample received 17 May, 2011

- The use of selective flotation resulted in the highest recoveries, up to 93%. The results of the batch and locked cycle flotation on the west composite indicated 93% Ag could be recovered to a 6.4 wt% weight pull concentrate with a 10,600 g/t silver grade. The cleaner test was performed without regrind of the rougher concentrate. Tests indicated that a much higher silver grades could be obtained with regrind. However, the relatively high content of arsenic, antimony and bismuth of the concentrate are a marketing concern
- Flotation recovery variability was indicated in flotation response going from the west (93%) to the central (60%) and east 88% zones and lower flotation recoveries were observed. The silver mineralization appears to be different in these zones, but additional mineralogical and testwork needs to be completed to identify the specific silver minerals which have not been differentiated to date as well as understand the main recovery variability drivers. The use of cyanidation of flotation tails in the central and east zone appears to be an option to improve overall silver recovery in those zones to about 80 to 90%.

The currently-preferred flowsheet is selective flotation to produce a concentrate followed by cyanidation of tailings to produce doré. Based on the composite samples tested to date, an overall average silver recovery of about 88% could be assumed to be achieved using this hybrid flowsheet. Recovery variability for both flotation and cyanidation is indicated by zone, possibly driven by variations in silver mineralogy and oxidation state, but the use of the hybrid flowsheet generally maintains overall silver recovery in this range. Such assumptions should be confirmed by additional testwork and trade-off studies.

Based on the current testwork results, any concentrates produced could potentially be difficult to market, and contain high level of arsenic, antimony and bismuth impurities, which will result in higher concentrate treatment charges and trigger penalties.

With higher grades of zinc mineralization in the mill feed material, there may be a possibility to produce a supplementary zinc concentrate. This scenario should be investigated in future studies.

13.4 Metallurgical Variability

Recovery variability is noted in testwork across the deposit from west to east suggesting a change in silver mineralization that has yet to be identified. There also appears to be a change in hardness of the mineralized material, possibly associated with lower-grade material, that should be investigated further.

13.5 Deleterious Elements

Based on current testwork results, the concentrates that may be produced could contain arsenic, antimony and bismuth impurities, which could potentially result in higher concentrate treatment charges; the potentially elevated levels of arsenic in concentrate may incur a minor penalty charge.

13.6 Comments on Section 13

Additional mineralogical and geometallurgical studies and testwork are recommended to understand flotation and cyanidation recovery variability observed between the samples collected for historical testwork represented as west and the central and east zones. This will also help define geometallurgical zoning or domains more precisely relative to silver mineralogy and oxidation state and understand if flotation can be improved to reduce the need to consider cyanidation on the flotation tailings to maintain overall recoveries at acceptable levels.

14.0 MINERAL RESOURCE ESTIMATES

14.1 Introduction

Traditional Mineral Resource modeling methods are commonly undertaken by manually constructing wireframes around the economic mineralization. Such methods are labour intensive, time consuming, and difficult to update with additional drilling or changing cut-off grades. Due to these concerns, a hybrid silver model was constructed by first defining the overall geometry of the silver mineralization using implicit modeling software, and then estimated resources within the Ag shell using probability assigned constrained kriging (PACK). Major steps for the modeling process included:

- Perform exploratory data analyses (EDA) to better understand the geologic controls on the silver mineralization
- Define the structural trends that control the geometry of the silver mineralization using geochemical depletion and enrichment studies, base-metal assay trends, and silver assay trends
- Construct a wireframe or mineralized shell using a 150 g/t Ag threshold using commercially-available Leapfrog Geo software that honours the structural trends defined during the EDA studies
- Estimate silver grades within the mineralized shell using PACK. PACK first constructs a probabilistic model or envelope using an indicator model within the implicit model shell. An indicator threshold is then chosen, and blocks with an estimated indicator above this threshold are used to define an envelope around the economic mineralization. Elements are then estimated into these blocks using ordinary kriging (OK) of only the composites within these blocks
- The PACK method prevents economic grades inside the probabilistic envelope from being smeared into the waste, and restricts low-grade material outside the probabilistic envelope from diluting the mineralized material inside the envelope
- A series of PACK models were constructed using a range of silver thresholds to evaluate how tonnages and silver grades vary using different silver thresholds. The models were then evaluated, and the model based on a 250 g/t Ag threshold was selected for Mineral Resource estimation purposes.

14.2 Exploratory Data Analysis

14.2.1 Database and Statistical Studies

The cut-off date for exporting the drill holes from the database to be used in the resource model was February 13, 2018. The database contained 389 drill holes with a total of 98,968.7 m of drilling. Of this dataset, 331 drill holes (80,955.0 m) have collar coordinates within the Yaxtché deposit that were used to construct the Mineral Resource model.

In general, the drill-hole spacing ranged from 5 to 60 m and averaged approximately 20 m. Azimuths of the drill holes range between 140–220º with two main populations orientated at 155º and 205º. Inclination of the drill holes vary from -45º to -90º with a median of -65º. A total of 51% of the 1 m drill hole intervals were “visually assayed”, determined to be void of mineralization, and not sampled. For these intervals silver, gold, copper, lead, and zinc assays were assigned a value of 0.0001 g/t for statistical analyses and Mineral Resource estimation purposes.

For initial statistical studies, the drill data set was selected using all data within the Yaxtché area. Initial visual review of the data, however, showed distinct differences in assay values between Yaxtché West (YW, X<3,419,320) and Yaxtché Central (YC, X≥ 3,419,320). As an example, sodium showed a very clear zonation (Figure 14-1).

To filter out non-mineralized material that may mask the EDA and capping studies, a 150 g/t (ppm) Ag shell was constructed, and 1 m composites inside the shell were used for EDA and capping studies. Initial studies were categorized using two domains, Yaxtché West and Yaxtché Central. Drill collar locations within each domain are shown in Figure 14-2.

The main EDA studies undertaken were:

- Univariate statistics for key elements
- Silver histograms and probability plots
- Boxplots categorized by alteration
- Boxplots categorized by lithology
- Correlation coefficients for key elements.

Figure 14-1: Example of Element Zonation Between Yaxtché West and Central Using Na%

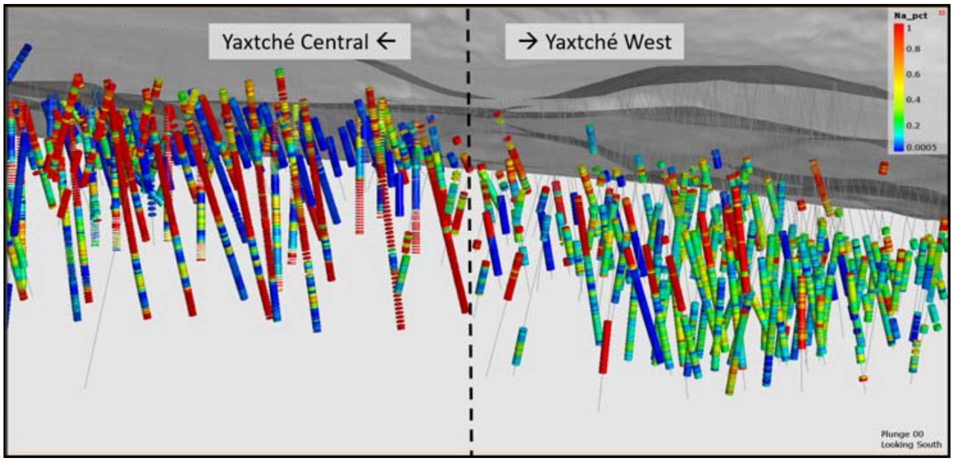


Figure prepared by Wood, 2018

Figure 14-2: Yaxtché Domains with All Drill Hole Collars in the Database

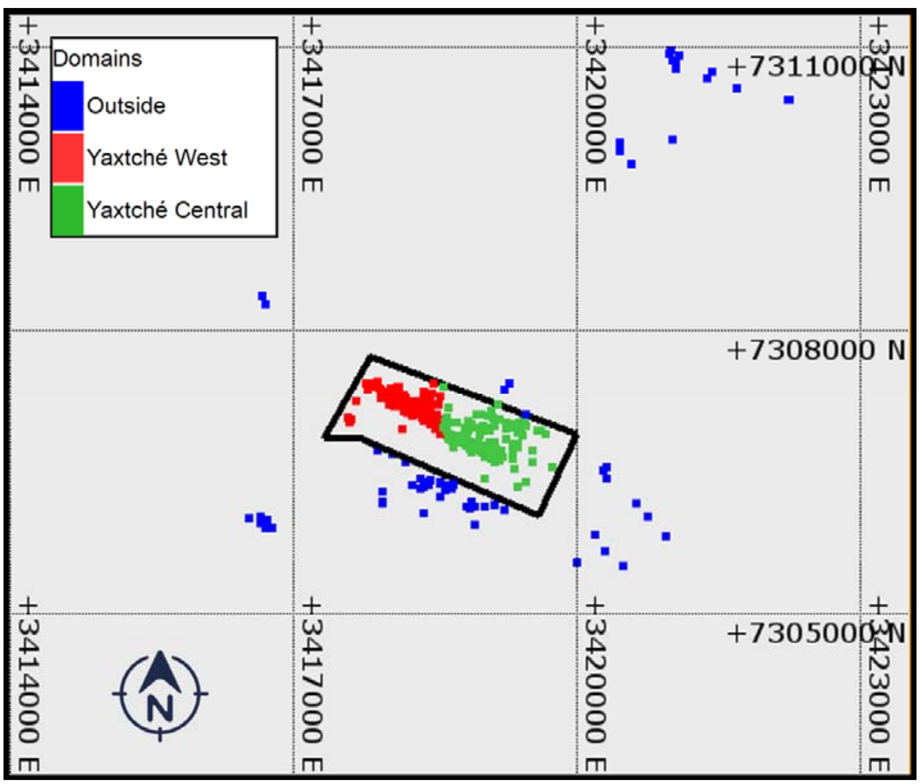


Figure prepared by Wood, 2018

Key findings from the EDA statistical studies include:

- Although statistics for the key elements can be similar, visually-distinct spatial zonations were observed
- Silver appears to be a single population above 10 g/t Ag
- A significant portion of the silver composites within the 150 g/t Ag shell are <150 g/t (75% in Yaxtché West and 80% in Yaxtché Central), indicating that a modeling method such as PACK needs to be incorporated to minimize diluting the higher-grade material
- Correlation coefficients show associations between Ag/Cu/As/Sb
- Although a stronger correlation probably exists between silver and sulphur on a mineralogical level as suggested by correlation between silver, arsenic and antimony, this correlation is probably masked by the much larger episode of non-argentiferous sulphide mineralization
- Statistics categorized by lithology should be used with caution as several of the codes (e.g. MS or mineralized structure) are a combination of lithology and visually-observed alteration and mineralization. The contact breccia (CB), however, does appear to control mineralization and should be evaluated in more detail for future models
- Boxplots show that higher alteration codes (3 is the highest) are correlated to lower calcium, magnesium and sodium grades and higher silver grades. As a result, the more quantitative calcium, magnesium and sodium assays should be evaluated to define the alteration in preference to the less reliable 0–3 alteration code that was visually logged.

14.2.2 Core Recovery

The possible effects of low core recovery on grades were evaluated by constructing boxplots for silver, copper, lead, zinc, arsenic and antimony with the data binned by percent core recovery. Results from the core recovery studies are as follows:

- In Yaxtché West, 93% of the samples have core recoveries greater than 80%, and 94% of the samples in Yaxtché Central have core recoveries greater than 80%, which are acceptable core recoveries for resource estimation
- No correlation exists between any of the elements and core recovery
- There is no reliable determination if silver grades increase or decrease with lower core recoveries since there are very few samples with low core recoveries.

Examples for silver are shown for Yaxtché West in Figure 14-3, and for Yaxtché Central in Figure 14-4.

Figure 14-3: Yaxtché West, Ag Grades Categorized by Core Recovery

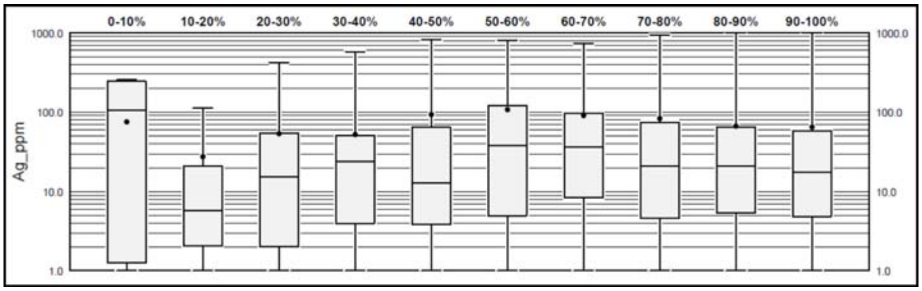


Figure prepared by Wood, 2018

Figure 14-4: Yaxtché Central, Ag Grades Categorized by Core Recovery

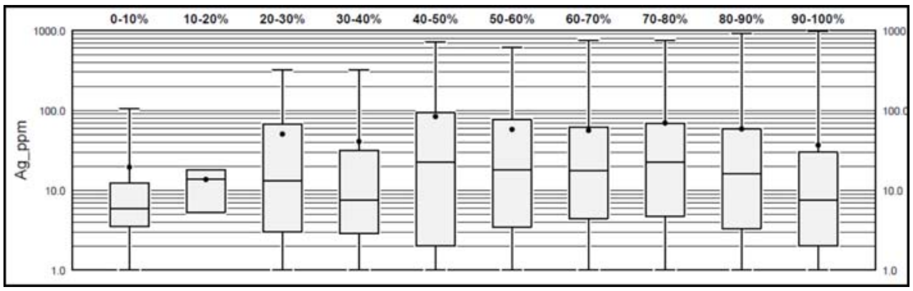


Figure prepared by Wood, 2018

14.3 Geological Models

14.3.1 Visual Zonation Studies

In order to better understand the relationships between copper, lead, zinc, arsenic, antimony and silver zonations, wireframes were constructed for each of these elements and viewed visually. Thresholds used in Figure 14-5 through Figure 14-9 for copper, lead, zinc, arsenic, and antimony were adjusted to best illustrate the zonations, and do not correspond to any economic or metallurgical threshold. The 150 g/t Ag shell (in red) is shown as a reference. The zonations were later used to model these elements to better understand how these elements may affect metallurgical recoveries.

Figure 14-5: Perspective View Looking South of the 150 g/t Ag Shell (red) in Relation to Cu Mineralization (green)

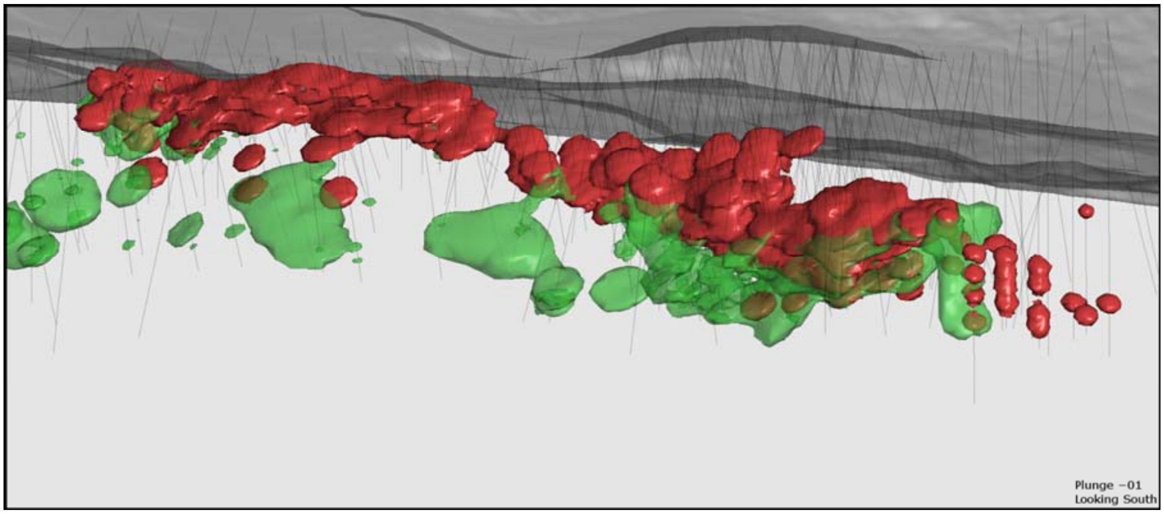


Figure prepared by Wood, 2018

Figure 14-6: Perspective View Looking South of the 150 g/t Ag Shell (Red) in Relation to Pb Mineralization (Purple)

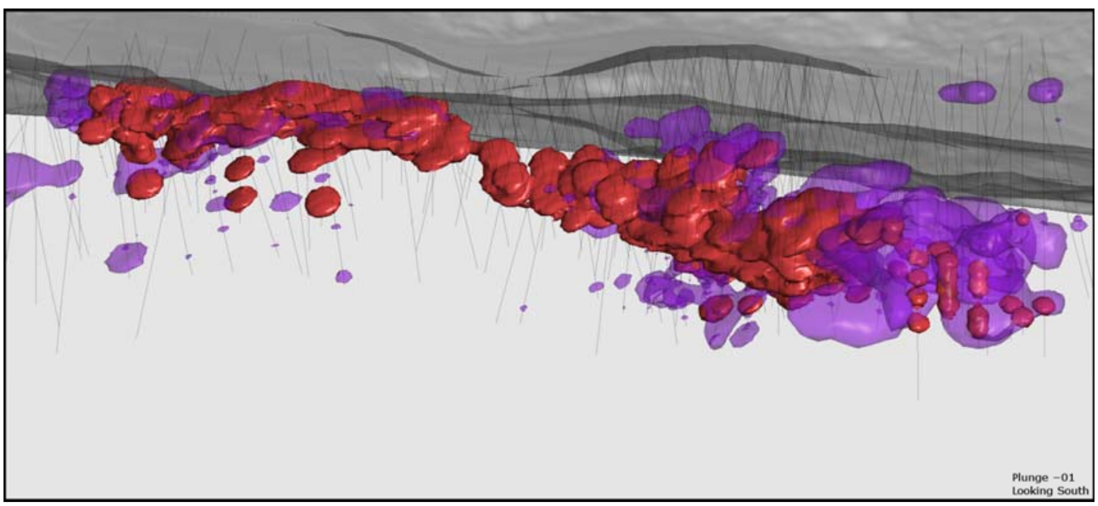


Figure prepared by Wood, 2018

Figure 14-7: Perspective View Looking South of the 150 g/t Ag Shell (Red) in Relation to Zn Mineralization (Cyan)

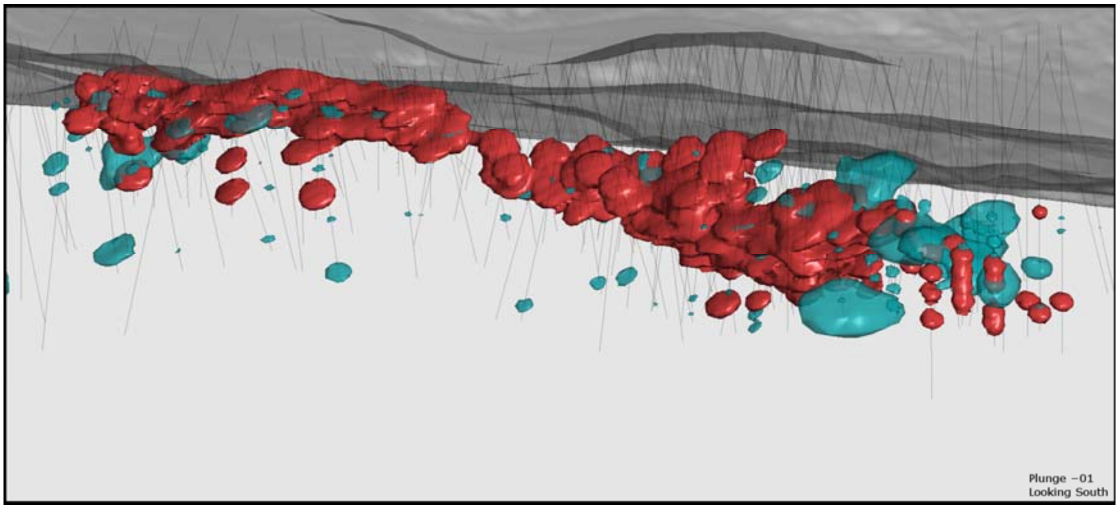


Figure prepared by Wood, 2018

Figure 14-8: Perspective View Looking South of the 150 g/t Ag Shell (Red) in Relation to the As Mineralization (Brown)

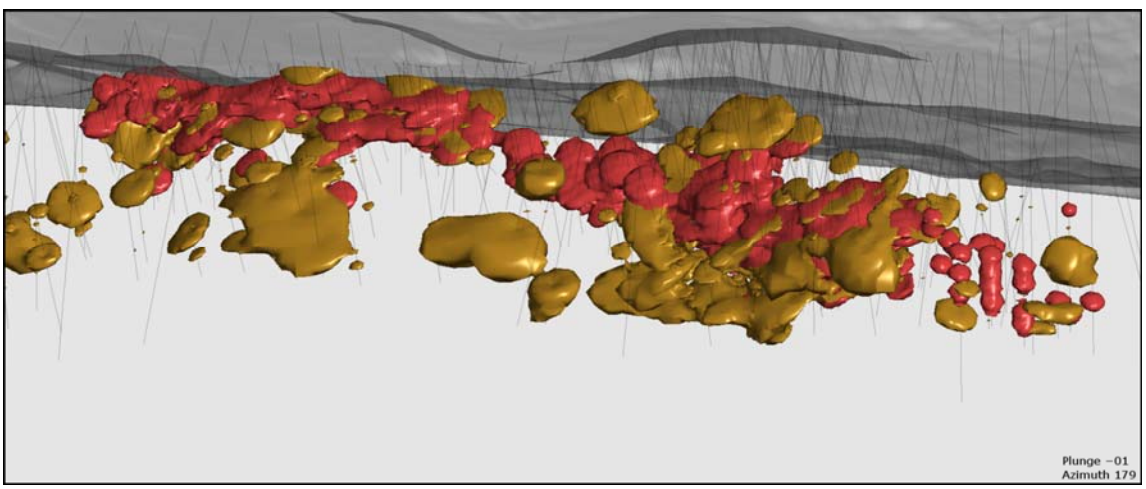


Figure prepared by Wood, 2018

Figure 14-9: Perspective View Looking South of the 150 g/t Ag Shell (Red) in Relation to the Sb Mineralization (Blue)

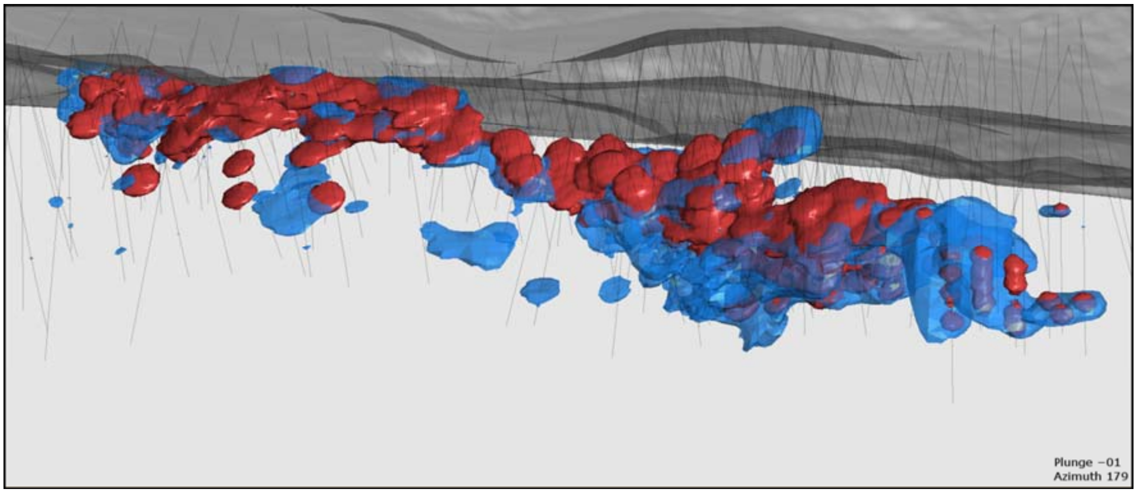


Figure prepared by Wood, 2018

Key findings from the visual zonation studies are as follows:

- Copper typically occurs below the silver mineralization
- Lead and zinc occur together and are more extensive towards the western end of the silver mineralization
- Arsenic and antimony occur together within and below the silver mineralization.

14.3.2 Alteration Model (QAI)

EDA studies using boxplots showed that higher alteration intensity codes (visually logged codes that range from 0–3) correlate to higher silver grades and lower calcium, magnesium and sodium grades. Since the calcium, magnesium and sodium assays are more quantitative than the logged alteration codes, a Quevar alteration index (QAI) was created to better delineate the geometry of the alteration that can then be used to help define the geometry of the silver mineralization. The derivation of the QAI is discussed in Section 7.3.3.

A wireframe was constructed for QAI review purposes, where samples have a 60% chance of having an QAI>40 (Figure 14-10 and Figure 14-11).

Figure 14-10: Perspective View Looking South of the 150 g/t Ag Shell (Red) in Relation to the Quevar Alteration Index (QAI) (Yellow)

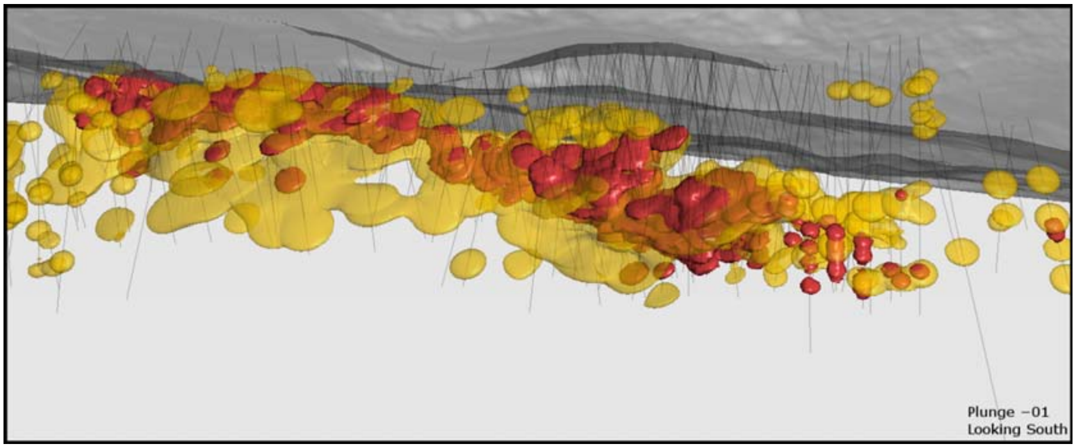


Figure prepared by Wood, 2018

Figure 14-11: Cross Section Looking 300º Showing the 150 g/t Ag Shell (Dark Gray) in Relation to the Alteration Index (QAI) (Yellow)

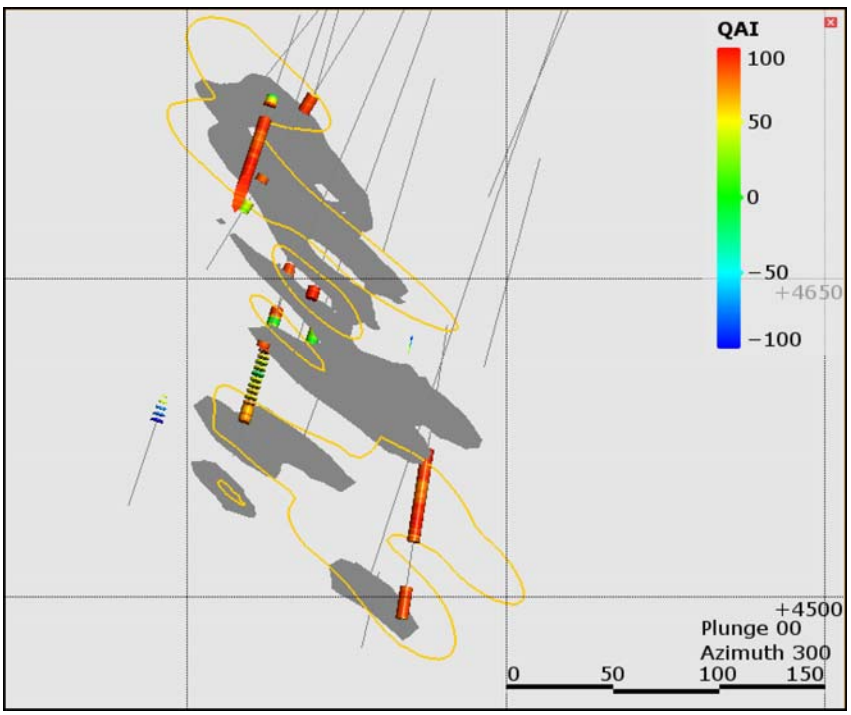


Figure prepared by Wood, 2018

Key findings from the alteration index studies are as follows:

- Higher-grade silver mineralization correlates to more intense alteration
- Alteration can be more precisely quantified using the calcium, magnesium and sodium assays that are depleted during alteration using a relative QAI
- Although the QAI visually follows the silver mineralization, it is not an exact correlation and economic mineralization occurs both inside and outside of the QAI shells
- QAI can only be used to help define the geometry of the silver mineralization, it cannot be used alone to define the geometry of the silver mineralization. It should, however, be evaluated as an exploration tool to guide future drilling.

14.3.3 Silver Grade Shell

The limits of the potentially economic mineralization were established by constructing a 150 g/t Ag wireframe shell. The shell was made within a defined boundary, sufficiently large enough to cover areas of interest for block modeling (refer to Figure 14-2). The edges of the shell were softened to allow the mineralization to be projected along strike to a reasonable distance. Although this incorporates lower-grade composites into the shell, the PACK estimation method excludes these low-grade assays from the mineralized envelope during grade estimation.

Drill data used to construct the shell were first composited using Datamine RM software version 1.3.41.2, and then imported into Leapfrog Geo software version 4.2.3 for the construction of the wireframe shell.

Structural trends controlling the silver mineralization were delineated using grade trends, the QAI alteration index, and key lithological units. The trends were recorded using digital terrain model wireframes (DTM), and then imported into Leapfrog Geo software. The composites and the structural trends were then used together to construct a 150 g/t Ag wireframe shell. The grade shell was then imported into Datamine studio for resource estimation. The structural trends vary locally but generally strike 120º and dip -40º to the northeast (Figure 14-12).

Figure 14-12: Perspective View Looking South of the 150 g/t Ag Grade Shell (Red) and the Ag Composites >150 g/t (White)

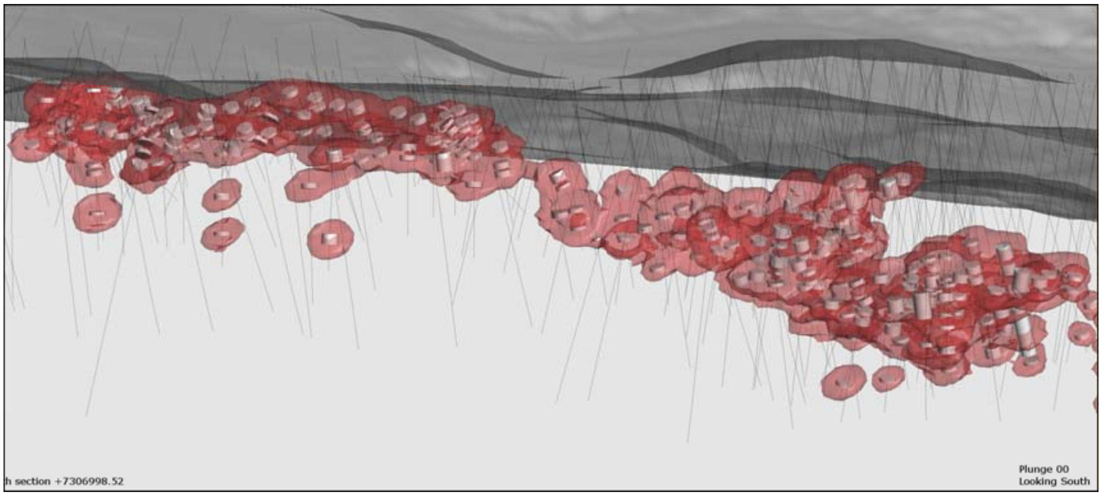


Figure prepared by Wood, 2018

14.3.4 Oxide–Sulphide Boundary

Visually-logged oxide, sulphide and mixed codes in the database (OXIDOS, SULFURO, and MIXTO) were refined by comparing the logged codes to the core photos and codes in adjacent holes. Since the processing method currently being evaluated is a sulphide mill, the mixed material was combined with the oxide, and a near-horizontal DTM was constructed to delineate oxide above and sulphide below the DTM (Figure 14-13). Figure 14-14 shows that a portion of 150 g/t Ag shell occurs in upper portions of Yaxtché East. This oxide portion has the potential of being a lower-grade open-pit oxide deposit, but this would require a separate resource model designed using a lower-cut-off grade, refinement of the oxide–mixed logged codes, and consideration of reasonable prospects for eventual economic extraction.

14.4 Density Assignment

Density measurements were performed on 1,568 unwaxed diamond-drill core samples by the on-site exploration geologists using the water displacement method. During the site visit, Wood collected eight samples that had previously been measured for SG using un-waxed volumetric method by on-site Golden Minerals personnel. These samples were sent to Alex Stewart for re-analysis using both the waxed and unwaxed SG methods. Results showed little difference between the on-site unwaxed measurements and the waxed measurements at the laboratory.

Figure 14-13: Perspective View Looking South of the Oxide-Mixed-Sulphide Codes and the DTM used to Delineate Oxide and Sulphide in the Resource Model

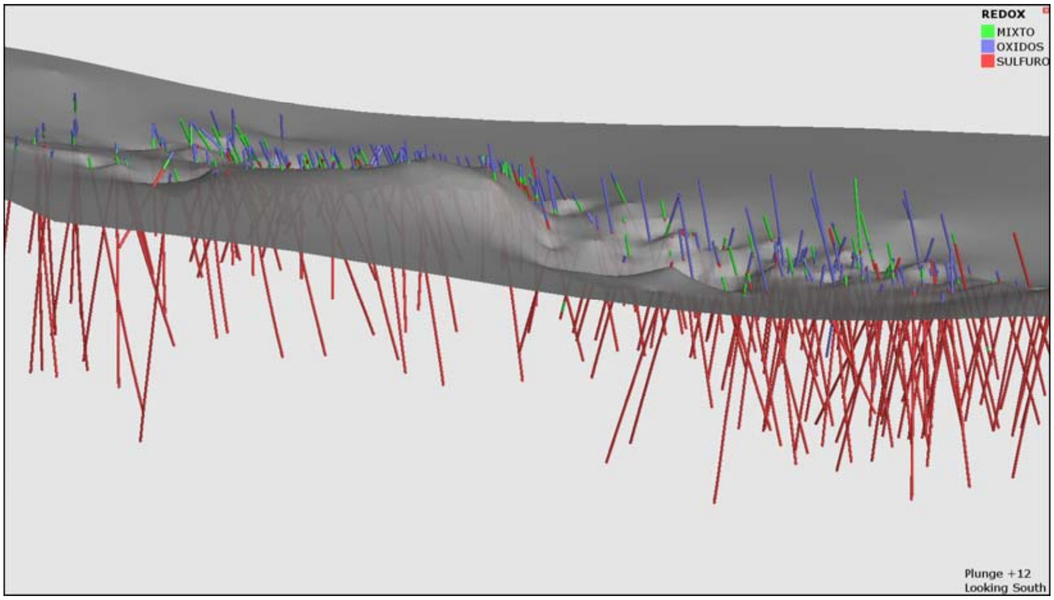


Figure prepared by Wood, 2018

Figure 14-14: Perspective View Looking South 150 g/t Ag Shell and the DTM used to Delineate Oxide and Sulphide in the Resource Model

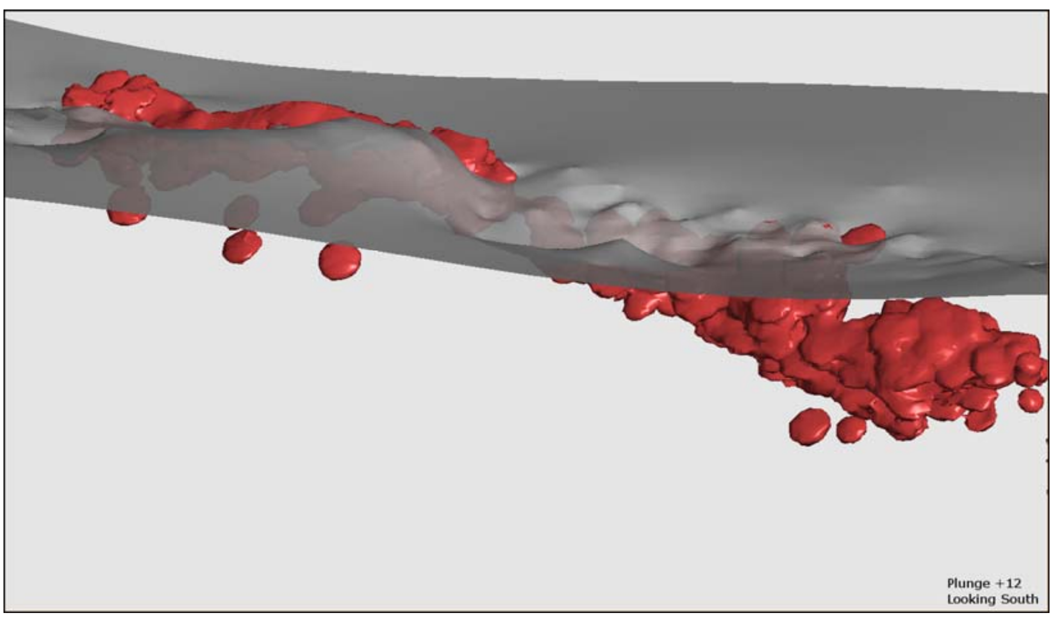


Figure prepared by Wood, 2018

Density data were recorded in the database, and reviewed spatially and statistically. The spatial review showed the density samples to be representative of the deposit, Figure 14-15. Statistical review showed several density values fell outside the expected upper and lower density limits. These samples were determined to be outliers and removed (Figure 14-16).

The relative high variability (coefficient of variation = 0.09) of the SG values was noted and attributed to the various degrees of brecciation of the dacite.

Density values were estimated into the block model separately for oxide and sulphide using inverse distance squared (ID2) method and an anisotropic flat-lying search (search distances in X and Y direction were three times the distances vertically) to reflect the near-horizontal oxide-sulphide boundary.

14.5 Grade Capping/Outlier Restrictions

In mineral deposits having skewed distributions, it is not uncommon for 1% of the highest assays to disproportionately account for over 20% of the total metal content in the resource model. Although these assays are real and reproducible, they commonly show little continuity, and add a significant amount of uncertainty to the mineral resource estimate.

Since high-grade material is not usually drilled to a suitable spacing to verify its spatial limits, the very high-grade assays should be constrained during Mineral Resource estimation to minimize the high risk of this material and local grade overestimation. One way to minimize the influence of these samples is to apply a top cut or cap grade to the assays before compositing and mineral resource estimation.

To determine an appropriate capping grade, capping studies were performed for Yaxtché West and Yaxtché Central domains. The capping studies performed were:

- Looking for kinks or discontinuities in cumulative log probability plot (CLPP)
- Decile analysis
- Quantifying the number of high-grade samples lying in close proximity to each other (Dist)
- Filtering higher-grade assays, and filtering the assays to determine when the higher-grade assays begin to cluster together.

Figure 14-15:Perspective View Looking South of Distribution of Density Samples

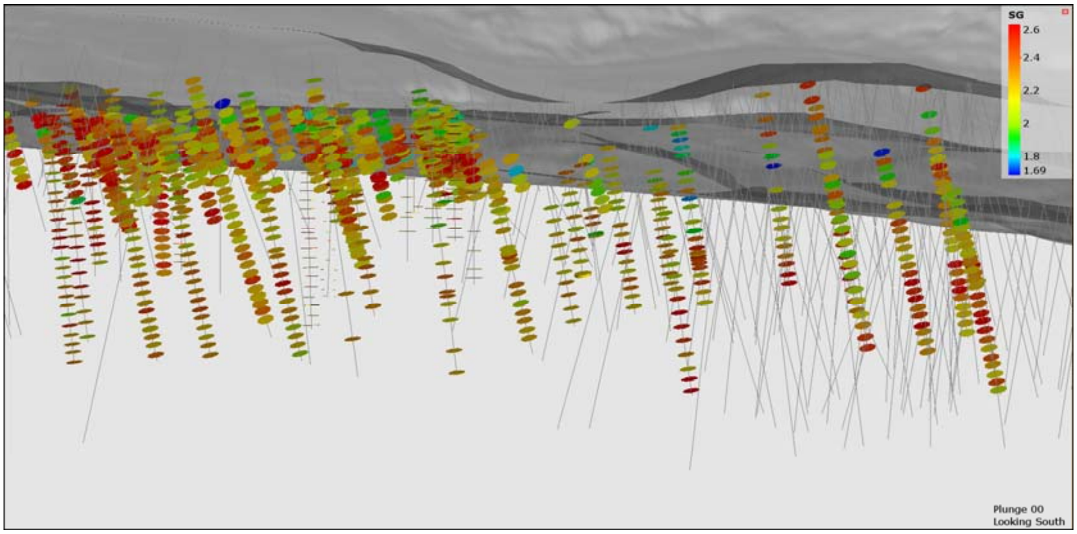


Figure prepared by Wood, 2018

Figure 14-16:Histogram of SG Values Showing Lower and Upper Trimming

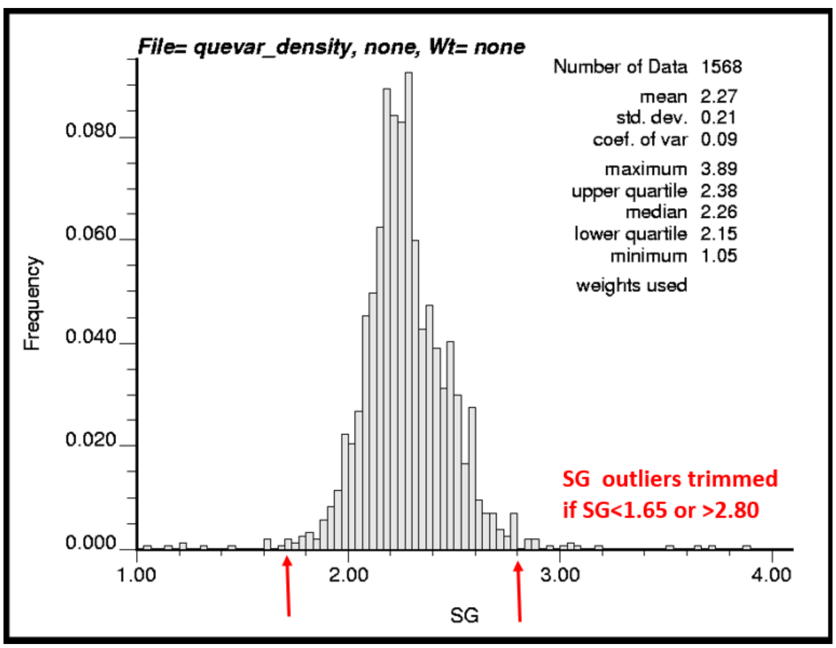


Figure prepared by Wood, 2018

Results for each capping method were compared and a final capping threshold was selected, Table 14-1. Capping was performed on the 1 m composites before further compositing into the 2.5 m composites used for the Mineral Resource estimations.

For arsenic and antimony, no capping was applied since many assays exceed the upper limit of the assay method used. As a result, the arsenic and antimony models should be used with caution as the assays in the database and model do not represent the very high arsenic and antimony grades.

14.6 Composites

For grade estimations, the samples were first capped and then composited into 2.5 m down-hole composite intervals to match the proposed mining height. Statistics for 2.5 m composites within the 150 g/t Ag shell and 250 g/t Ag PACK envelope are summarized in Table 14-2. There is a high percentage of composites with Ag grades below 150 g/t within the 150 g/t Ag shell. The PACK estimation method was selected for grade estimation as it excludes these lower-grade composites from being used during grade estimation. The last column in Table 14-2 provides the composite statistics used for final PACK grade estimation.

14.7 Variography

Review of the structural, assay trends and QAI studies showed that the trend of the Ag mineralization is relatively consistent, following a strike of 120º and dipping at -40º to the northeast. As no obvious changes in direction were noted between Yaxtché West and Yaxtché Central, variograms and grade estimations were performed for both domains combined to avoid any unnecessary artefacts that may occur at domain boundaries if the domains were estimated separately. Any local variations within the overall trend were accounted for by using dynamic anisotropy during grade estimations which aligns the search ellipse with the structural trends for every block in the model during grade estimation.

Variograms (correlograms) were calculated and modeled following the main structural trend (along strike, down-dip, and perpendicular) for silver, copper, lead and zinc using the 2.5 m composites within the 150 g/t Ag shell. The nugget effects for each variogram were first established using down-hole variograms and then directional variograms were modeled using the nugget effect established from the down-hole variograms. An example of modeled silver variograms in three primary directions are shown in Figure 14-17 and summarized in Table 14-3.

Table 14-1: Capping Thresholds, Final Capping Values Highlighted in Gray

	Metal	CLPP	Parish	Dist	Visual	Avg	Final	Metal Removed (%)
Yaxtché West	Ag_ppm	1800	1902	1500	1640	1711	1800	12
	Au_ppm	0.35	0.28	0.40	0.25	0.32	0.32	32
	Cu_pct	1.50	1.24	0.90	1.20	1.21	1.50	9
	Pb_pct	4.00	3.22	3.00	2.70	3.23	4.00	12
	Zn_pct	2.50	1.77	2.00	1.80	2.02	2.50	9
Yaxtché Central	Ag_ppm	1500	1899	1400	1288	1522	1600	15
	Au_ppm	0.60	0.34	0.40	0.12	0.37	0.50	15
	Cu_pct	1.00	1.00	1.00	0.90	0.98	1.00	9
	Pb_pct	4.00	2.90	2.00	3.80	3.18	4.00	5
	Zn_pct	1.80	1.70	1.50	1.00	1.50	1.80	6

Table 14-2: Drill Composite Statistics (2.5 m capped composites)

	Within 150 g/t Grade Shell								Within PACK Envelope
Element	Ag_ppm	Au_ppm	Cu_pct	Pb_pct	Zn_pct	S_pct	As_ppm	Sb_ppm	Ag_ppm
No Samples	3,584	3,584	3,584	3,584	3,584	3,584	3,584	3,584	598
Mean	116	0.02	0.07	0.22	0.12	4.23	478	354	437
Std Dev	201.10	0.04	0.15	0.42	0.26	2.55	774.25	449.97	306.53
CV	1.74	2.69	2.19	1.93	2.20	0.60	1.62	1.27	0.70
Maximum	1800	0.32	1.50	4.00	2.50	13.75	11919	3808	1800
Q75	131	0.01	0.06	0.21	0.09	6.02	523	482	574
Q50	37	0.01	0.01	0.11	0.02	3.92	251	173	361
Q25	5	0.00	0.00	0.03	0.00	2.26	124	40	261
Minimum	0	0.00	0.00	0.00	0.00	0.04	3	0	0

Figure 14-17: Example Variograms for Ag

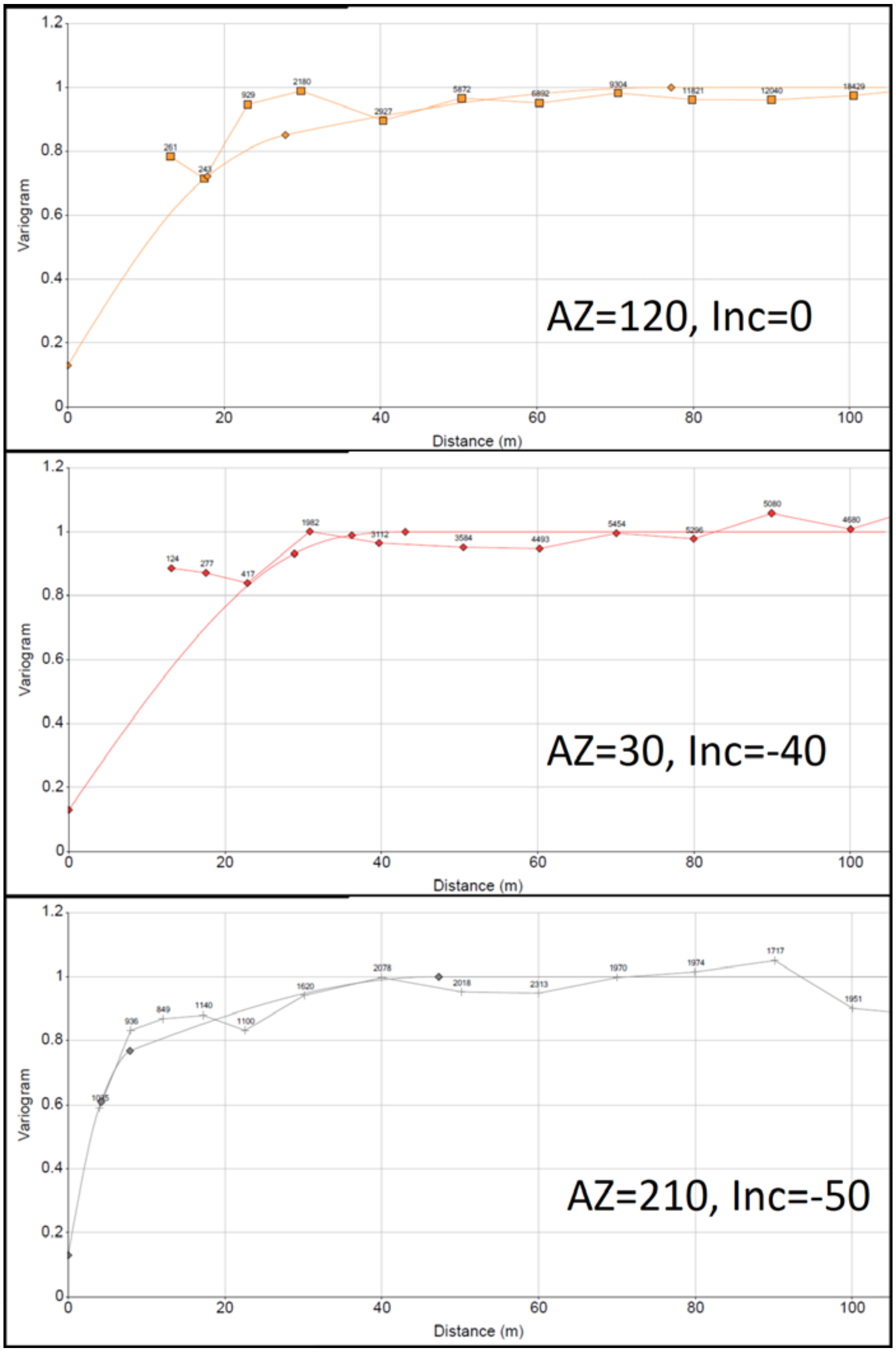


Figure prepared by Wood, 2018

Table 14-3: Variogram Parameters

Azimuth / Inclination	Element	Left-hand Rotations Z / Y / X	Axis	Nugget Effect	Structures C1/C2/C3	Ranges a1/a2/a3
120 / 0	Ag	30 / 0 / 40	X	0.13	0.13 / 0.43 / 0.31	18 / 28 / 77
30 / -40			Y		0.13 / 0.43 / 0.31	29 / 36 / 43
210 / -50			Z		0.13 / 0.43 / 0.31	4 / 8 / 47
120 / 0	Au	30 / 0 / 40	X	0.05	0.09 / 0.47 / 0.39	14 / 47 / 160
30 / -40			Y		0.09 / 0.47 / 0.39	34 / 44 / 95
210 / -50			Z		0.09 / 0.47 / 0.39	5 / 11 / 140
120 / 0	Cu	30 / 0 / 40	X	0.21	0.28 / 0.25 / 0.26	14 / 42 / 140
30 / -40			Y		0.28 / 0.25 / 0.26	24 / 54 / 78
210 / -50			Z		0.28 / 0.25 / 0.26	9 / 32 / 87
120 / 0	Pb	30 / 0 / 40	X	0.2	0.3 / 0.2 / 0.3	20 / 52 / 100
30 / -40			Y		0.3 / 0.2 / 0.3	9 / 13 / 52
210 / -50			Z		0.3 / 0.2 / 0.3	18 / 42 / 48
120 / 0	Zn	30 / 0 / 40	X	0.2	0.05 / 0.59 / 0.16	11 / 27 / 84
30 / -40			Y		0.05 / 0.59 / 0.16	28 / 34 / 47
210 / -50			Z		0.05 / 0.59 / 0.16	5 / 13 / 40

14.8 Silver Estimation

The PACK estimation method was selected for its ease in constructing of multiple models using different silver thresholds. The resulting tonnes and grades derived from these models were evaluated. Sensitivity models were constructed using silver thresholds of 150, 200, and 250 g/t Ag. A 250 g/t Ag model was selected for Mineral Resource estimation purposes.

The PACK estimation method for silver first constructs an indicator model based on a silver threshold, tags the estimated indicator into the composite file, and then estimates silver grades using only the blocks and composites with an estimated indicator above a specified value. The PACK modeling method also allows the model to be easily updated with additional drilling, modifications to the mining method, or changes in cut-off grades.

The main steps to construct the 250 g/t Ag resource model were as follows:

- The extents of the silver mineralization were defined using 150 g/t Ag wireframe shell as described in Section 14.3.3
- The 150 g/t Ag shell was populated with blocks rotated 30º clockwise around the Z axis. A block size 5.0 m x 2.5 m x 2.5 m (along strike, perpendicular to strike,

vertical) was selected to assist with mine planning, and the blocks were not sub-celled

- The 2.5 m composites within the 150 g/t Ag shell were flagged and used to construct an indicator model. An indicator field was first added to the composites. If the silver grade was <250 g/t, the indicator was set to 0, if the Ag grade was ≥250 g/t, the indicator was set to 1
- The indicators were estimated into the150 g/t Ag shell using inverse distance to the third power (ID3) using parameters shown in Table 14-4
- The estimated indicator values in the block model were then tagged back into the composites, and only blocks with an estimated indicator ≥0.30 were estimated using only those composites with tagged estimated indicator values ≥0.30. Figure 14-18 is an example cross section of the 250 g/t Ag indicator model within the 150 g/t Ag shell (black outline) showing estimated indicators in the model that range from 0–1, and composites coloured indicator (black = 1, gray = 0). Blocks with estimated indicators ≥0.30 are highlighted as solid blocks, and form the Mineral Resource model
- Figure 14-19 shows the silver grades estimated into the solid blocks using composites with estimated indicator ≥0.30, ordinary kriging, and the same estimation parameters as those used for the indicator model summarized in Table 14-4, and variogram parameters summarized in Table 14-3. Blocks with estimated indicator <0.30 (non-solid blocks) were estimated using the same method, but using composites with estimated indicators <0.30. These blocks were included to support future mine planning and dilution studies
- The solid blocks in Figure 14-19 are the Mineral Resource model blocks. The continuity of the mineralization could be increased by lowering the silver threshold which will significantly increase the number of blocks (tonnes) at the expense of lowering the grade.

14.9 Metallurgical Models

Although silver, copper, lead, zinc, arsenic and antimony were estimated, the model was optimized to estimate the Ag mineralization as it is the only economic contributor and only metal being reported as a Mineral Resource. Gold was estimated to determine if any significant gold credits could be expected, but gold grades were considered to be too low to warrant any further studies at this stage of Project evaluation.

Table 14-4: Estimation Parameters

Azimuth / Inclination	Field	Left-hand Rotations Z / Y / X	Search Pass 1		Search Pass 2		Search Pass 3		Maximum Number per Drill Hole
			Distance	Min / Max	Distance	Min / Max	Distance	Min / Max	
120 / 0	All indicators and elements	30 / 40 / 0	20	3 / 8	30	3 / 8	40	1 / 8	2
30 / -40			20	3 / 8	30	3 / 8	40	1 / 8	2
210 / -50			10	3 / 8	15	3 / 8	20	1 / 8	2

Figure 14-18: Example of Indicator Model

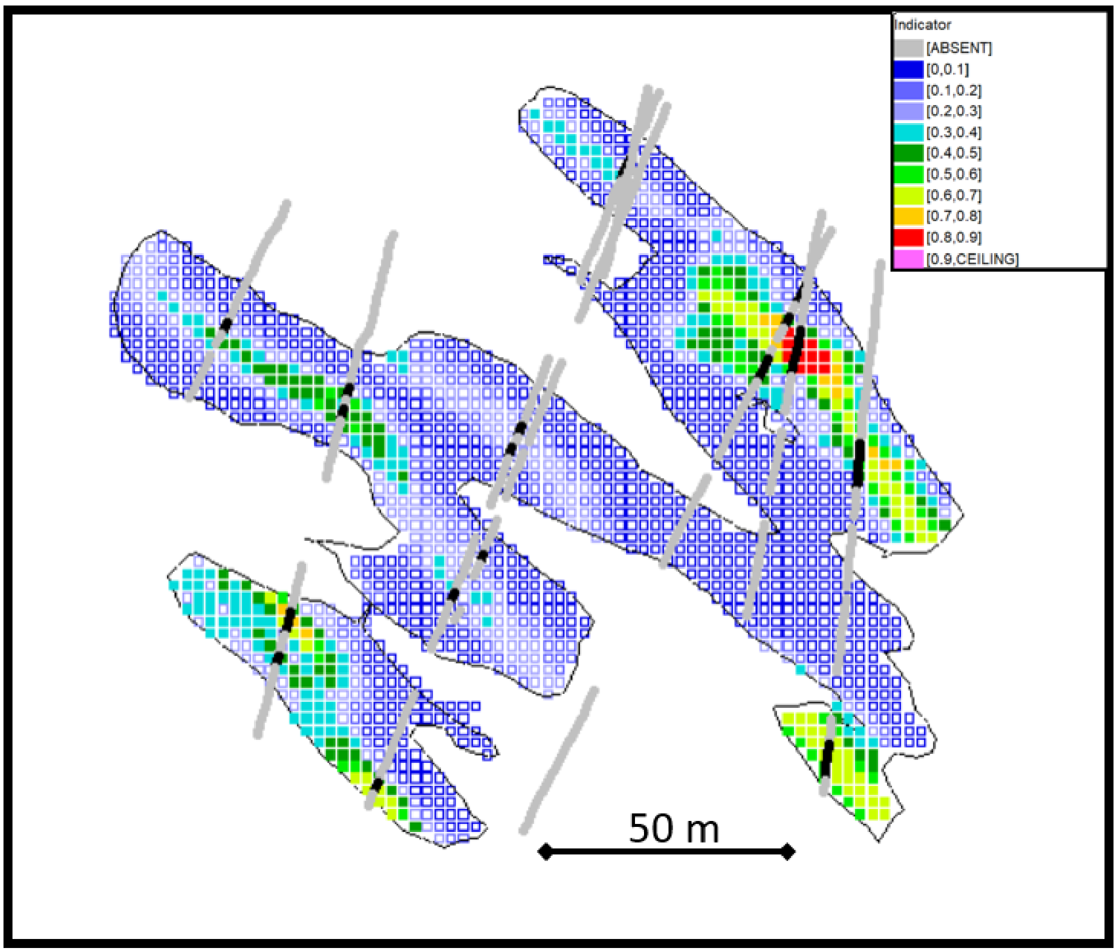


Figure prepared by Wood, 2018. Blocks with estimated indicator ≥ 0.3 are shown as solid. Composites coloured by indicator (black = 1, gray = 0)

Figure 14-19:Example of the PACK Ag Model

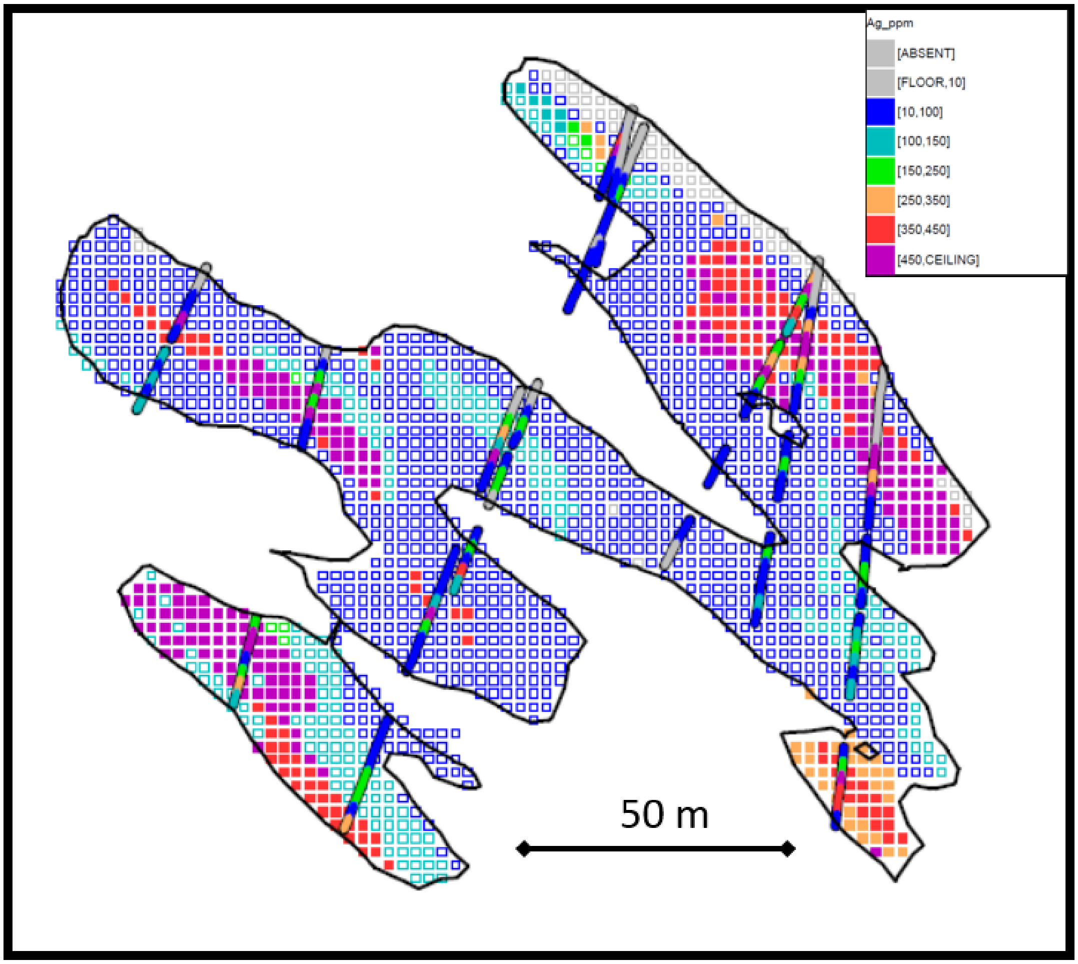


Figure prepared by Wood, 2018. Blocks estimated within the indicator envelope are shown as solid blocks.

Copper, lead, zinc, arsenic and antimony were estimated to better understand the deposit, and to assist with future metallurgical studies. Copper, lead, zinc, arsenic and antimony were estimated into all blocks within the 150 g/t Ag shell using a PACK modeling method similar to the silver estimation. The only difference was that instead of using a silver threshold based on economics, the thresholds were selected if the copper, lead, zinc, arsenic and antimony grades were above a threshold that would result in a penalty when selling the concentrates. If the grades were below the metallurgical penalty threshold and an inflection was recognized in the probability plots, the PACK threshold was set to the inflection. If no inflection was noted, the element was modeled as a single domain.

PACK thresholds used are as follows:

- Copper: 0.2% threshold. If grades exceed this value, the mill concentrates may occur a copper penalty. However, the amount of high-grade copper is small enough that the penalty may be avoided through blending
- Lead: too low for metallurgical threshold, inflection at 0.01% was used to domain and model the higher grades
- Zinc: too low for metallurgical threshold, weak inflection at 0.2% was used to domain and model the higher grades
- Arsenic: 200 g/t threshold. If grades exceed this value, the mill concentrates may occur an arsenic penalty
- Antimony: 0 g/t threshold, and mill concentrates are expected to occur an antimony penalty for all material.

14.10 Block Model Validation

14.10.1 Visual

The estimated silver grades in the model were compared to the composite grades by visual inspection in plan views, cross sections, and longitudinal sections. In general, the model and composite grades compared well.

14.10.2 Global Bias

The block model was checked for global bias by comparing the average silver, gold, copper, lead, and zinc grades (with no cut-off) from the model (OK grades) with means from nearest-neighbour (NN) estimates. The NN estimator produces a theoretically unbiased (declustered) estimate of the average value when no cut-off grade is imposed and provides a good basis for checking the performance of different estimation methods. In general, an estimate is considered acceptable if the bias is at or below 5%. Table 14-5 shows the bias results on a global basis.

14.10.3 Local Bias

Local trends in the grade estimates (swath checks) were performed by plotting the mean silver values from the NN estimate versus the kriged results along strike, along dip-direction and vertical directions. Swath plots by direction are shown in Figure 14-20 through Figure 14-22.

The swath grade profile plots help in assessing the local mean grades and are used to validate grade trends in the model. Although the global comparisons agree well, the swath plots illustrate the existence of slight local differences between the NN and kriged model grades. This is considered to be normal.

Table 14-5: Global Bias by Metal

Domain	Model OK	Model NN	Relative Diff
Ag_ppm	469	494	-4.9%
Au_ppm	0.02	0.02	-1.7%
Cu_pct	0.40	0.42	-4.9%
Pb_pct	0.23	0.23	0.4%
Zn_pct	0.29	0.29	-3.4%

Figure 14-20: Ag Grade Trends Along Strike

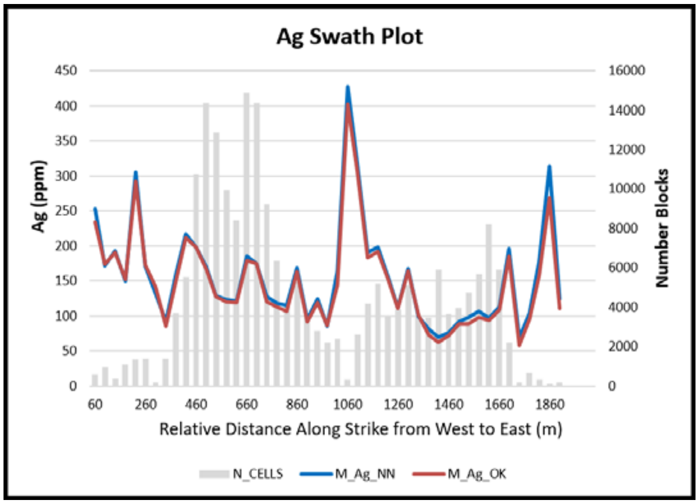


Figure prepared by Wood, 2018

Figure 14-21: Ag Grade Trends Along Dip-Direction

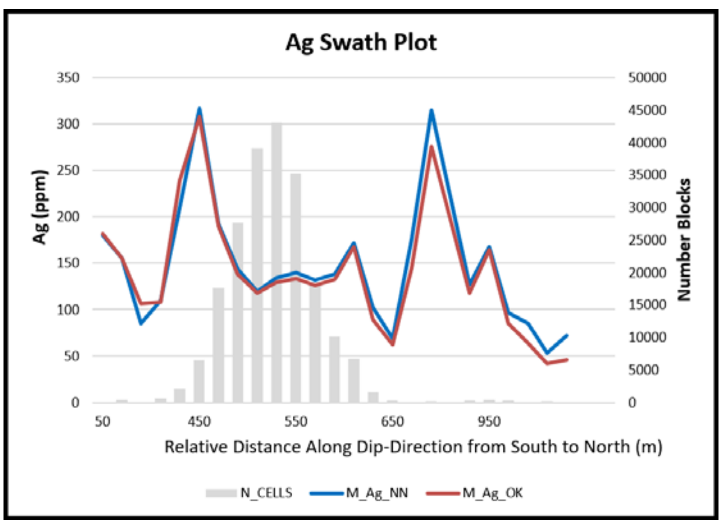


Figure prepared by Wood, 2018

Figure 14-22: Ag Grade Trends Along Relative Elevation

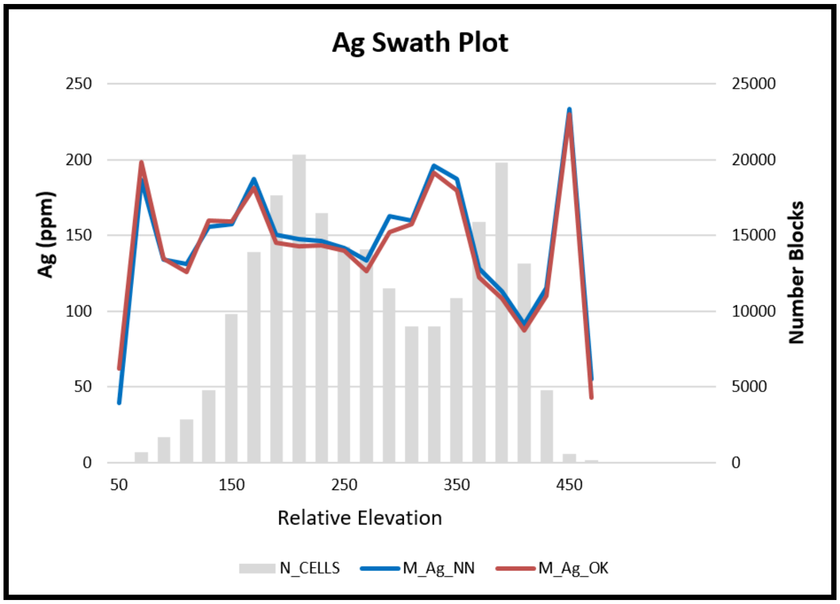


Figure prepared by Wood, 2018

14.11 Classification of Mineral Resources

Mineral Resources were classified using a common industry and Wood internal guideline that Indicated Mineral Resources should be quantified within relative ± 15% with 90% confidence on an annual basis, and Measured Mineral Resources should be known within ± 15% with 90% confidence on a quarterly basis. At this level, the drilling is usually sufficiently close-spaced enough to permit confirmation (Measured) or assumption of continuity (Indicated) between points of observation.

For the Yaxtché model, a drill hole spacing study was performed to determine the nominal drill hole spacing required to classify material as Indicated. Material within the 150 g/t Ag shell not classified as Indicated was classified as Inferred, and no Measured is reported.

Confidence limits were calculated on a single block that represents one month's production (365,000 t/a). The confidence limits, a review of continuity on sections and plans, and an assessment of data quality were all used to determine that a minimum drill hole spacing of 30 by 30 m was necessary to meet the requirements for Indicated. The classification was then smoothed to remove the isolated blocks with a different classification than the surrounding blocks.

14.12 Reasonable Prospects of Eventual Economic Extraction

Four underground mining methods that included sublevel end slicing, transverse with pillars, transverse with cemented fill, and random room-and-pillar were investigated to identify the potentially most favorable mining method for the Yaxtché underground resource deposit (Mineral Resources Engineering, 2018).

The comparative analysis supports the selection of the random room-and-pillar mining method as the best for the current Mineral Resource estimate, based on the criteria of overall resource extraction and the anticipated cost per contained ounce that could be delivered to a plant.

There are reasonable prospects for eventual economic extraction using the following assumptions: a silver price of $16.62/oz, employment of underground, mechanized, room-and-pillar mining methods, and silver concentrates will be produced and sold to a smelter. Mining costs are assumed to be $55/t at an nominal production rate of 365,000 t/a. Concentrator and general and administrative (G&A) costs are assumed to be $30/t and $20/t respectively. Metallurgical recovery of silver is assumed to be 88.5%.

14.13 Yaxtché Mineral Resource Statement

The Yaxtché underground resource model was constructed by Gordon Seibel, R.M. SME and Principal Geologist with Wood, in conjunction with Golden Minerals' personnel.

The resource model in this Report assumes that mining will be undertaken using underground methods. Although a portion of the mineralization is oxide material that could potentially support an open-pit oxide operation, this would require a different resource model than the one documented in this Report.

Gordon Seibel is the QP for the resource model and Mineral Resource estimate. The QP considers that the mineral resource models and Mineral Resource estimates derived from those models are consistent with the 2014 CIM Definition Standards and were performed in accordance with the 2003 CIM Best Practice Guidelines.

Mineral Resources are summarized in Table 14-6, and have an effective date of 26 February 2018.

Table 14-6: Mineral Resource Table (250 g/t Ag cutoff)

Class	Type	Tonnes (Mt)	Ag Grade (g/t)	Contained Ag Metal (Moz)
Indicated	Sulphide	2.63	487	41.1
	Oxide	0.30	434	4.2
	Total	***2.93***	***482***	***45.3***
Inferred	Sulphide	0.31	417	4.1
	Oxide	0.00	—	0.0
	Total	***0.31***	***417***	***4.1***

1) The independent Qualified Person who prepared the Mineral Resource estimate is Gordon Seibel, a Registered Member of the Society for Mining, Metallurgy and Exploration, RM SME, who is a Principal Geologist with Wood.

2) The effective date of the estimate is February 26, 2018. Mineral Resources are estimated using the CIM Definition Standards for Mineral Resources and Reserves (2014).

3) There are reasonable prospects for eventual economic extraction under assumptions of a silver price of $16.62/oz, employment of underground, mechanized, room-and-pillar mining methods, and that silver concentrates will be produced and sold to a smelter. Mining costs are assumed to be $55/t at a nominal production of rate 365,000 t/a. Concentrator and general and administrative (G&A) costs are assumed to be $30/t and $20/t respectively. Metallurgical recovery for silver is assumed to be 88.5%.

4) Reported Mineral Resources contain no allowances for hanging wall or footwall contact boundary loss and dilution. No mining recovery has been applied.

5) Rounding as required by reporting guidelines may result in apparent differences between tonnes, grade and contained metal content.

14.14 Sensitivity of Mineral Resources to Cut-off Grade

Table 14-7 through Table 14-9 summarise the Yaxtché Mineral Resource at a range of cut-off grades. The base case Mineral Resource model reported at a 250 g/t Ag cut-off is highlighted in grey. All sensitivity numbers are reported within the 250 g/t Ag PACK model. If the sensitivity study was performed using a different silver threshold for the PACK model, difference in tonnages and grades between cut-offs would be much larger.

Table 14-7: Indicated Sulphide Resource Sensitivity Table

Cut-off Ag (g/t)	Tonnes (Mt)	Ag Grade (g/t)	Contained Ag Metal (M oz)
300	2.46	501	39.7
250	2.63	487	41.1
200	2.66	484	41.4
150	2.66	483	41.4

The footnotes to Table 14-6 also apply to this table. Basecase is highlighted.

Table 14-8: Indicated Oxide Resource Sensitivity Table

Cut-off Ag (g/t)	Tonnes (Mt)	Ag Grade (g/t)	Contained Ag Metal (M oz)
300	0.26	456	3.8
250	0.30	434	4.2
200	0.31	429	4.2
150	0.31	428	4.3

The footnotes to Table 14-6 also apply to this table. Basecase is highlighted.

Table 14-9: Inferred Sulphide Resource Sensitivity Table

Cut-off Ag (g/t)	Tonnes (Mt)	Ag Grade (g/t)	Contained Ag Metal (M oz)
300	0.25	449	3.6
250	0.31	417	4.1
200	0.32	408	4.2
150	0.33	403	4.3

The footnotes to Table 14-6 also apply to this table. Basecase is highlighted.

14.15 Factors That May Affect the Mineral Resource Estimate

Factors that may affect the Mineral Resource estimate include:

- Commodity price assumptions
- Changes in local interpretations of mineralization geometry and continuity of mineralization zones, and impact on mining selectivity
- Changes to geotechnical, hydrogeological, and metallurgical recovery assumptions
- Density and domain assignments
- Changes to assumed mining method which may change block size and orientation assumptions used in the resource model

- Input factors used to assess reasonable prospects for eventual economic extraction
- Assumptions as to social, permitting and environmental conditions
- Additional infill or step out drilling; results obtained from extending the exploration decline.

14.16 Comments on Section 14

Mineral Resources for the Project have been estimated using core drill data, have been performed using industry best practices (CIM, 2003), and conform to the requirements of the 2014 CIM Definition Standards. Wood has checked the data used to construct the resource model. Wood finds the Yaxtché resource model to be suitable to support future preliminary economic assessment-level studies.

It is recommended that Golden Minerals extend the existing decline to expose the higher-grade mineralization to establish feasible ore control procedures that can practically define mill feed material and waste. Additional PACK modelling should be constructed to better understand how changes in silver prices, and exchange rates may affect the cut-off grade and considerations of reasonable prospects for eventual economic extraction.

The QP notes:

- Visual inspection of the core shows that the mineralization can be highly variable, and ore control procedures will need to be developed to address this variability during future mine planning
- The amount of contact dilution related to local undulations has yet to be determined
- Mining recovery could be lower, and dilution increased in the more complex portions of the deposit
- The exploration decline should provide an appropriate trial of the conceptual room-and-pillar mining method on the Yaxtché deposit in terms of costs, dilution, and mining recovery. The decline will also provide access to data and metallurgical samples at a bulk scale that cannot be collected at the scale of a drill sample
- Metallurgical recovery is a single recovery, the data used to support the recovery should be reviewed to determine if the data are representative of the variability within the deposit
- The relative high variability in the SG values should be studied to determine if additional SG estimation domains should be developed

- Changes in the assumptions as to conceptual operating costs may affect the base case cut-off grades selected for the Yaxtché Mineral Resource estimate.

There are no other known factors or issues not discussed in this Report that may materially affect the estimate other than normal risks faced by mining projects in terms of environmental, permitting, taxation, socio-economic, marketing and political factors.

15.0 MINERAL RESERVE ESTIMATES

This section is not relevant to this Report.

16.0 MINING METHODS

This section is not relevant to this Report.

17.0 RECOVERY METHODS

This section is not relevant to this Report.

18.0 PROJECT INFRASTRUCTURE

This section is not relevant to this Report.

19.0 MARKET STUDIES AND CONTRACTS

This section is not relevant to this Report.

20.0 ENVIRONMENTAL STUDIES, PERMITTING, AND SOCIAL OR COMMUNITY IMPACT

This section is not relevant to this Report.

21.0 CAPITAL AND OPERATING COSTS

This section is not relevant to this Report.

22.0 ECONOMIC ANALYSIS

This section is not relevant to this Report.

23.0 ADJACENT PROPERTIES

This section is not relevant to this Report.

24.0 OTHER RELEVANT DATA AND INFORMATION

This section is not relevant to this Report.

25.0 INTERPRETATION AND CONCLUSIONS

25.1 Introduction

The QPs note the following interpretations and conclusions in their respective areas of expertise, based on the review of data available for this Report.

25.2 Mineral Tenure, Surface Rights, Water Rights, Royalties and Agreements

- Legal opinion provided supports that Golden Minerals currently holds an indirect 100% interest in the El Quevar Project through its subsidiary Silex Argentina
- The AMC sets out rules under which surface rights and easements can be granted for a mining operation. In instances where no agreement can be reached with the landowner, the AMC provides the mining right holder with the right to expropriate the required property
- Water use rights may be acquired by permit, by concession, and, under laws enacted in some Provinces, through authorization
- Golden Minerals is required to pay a 1% NSR royalty on the value of all minerals extracted from the El Quevar II concession and a 1% NSR royalty on one-half of the minerals extracted from the Castor concession. Golden Minerals can purchase one half of the combined royalty interests for US$1 million during the first two years of production
- Golden Minerals may also be required to pay a 3% royalty to the Salta Province based on the mine mouth value of minerals extracted from any of the concessions unless new legislation is enacted by the Argentine Federal Congress that will allow Salta Province to levy up to 3% royalty of the gross revenue accrued in a year
- Silex Argentina maintains the required environmental permits. All previous work was completed under fully-authorized permits.

25.3 Geology and Mineralization

- Mineralization at the Yaxtché deposit is high-sulphidation in style
- The geological setting, mineralization style, and structural and stratigraphic controls are sufficiently well understood to provide useful guides to exploration and Mineral Resource estimation.

25.4 Exploration, Drilling and Analytical Data Collection in Support of Mineral Resource Estimation

- Exploration completed to date has resulted in delineation of the Yaxtché deposit and a number of exploration targets
- No drilling has been undertaken on the Project since 2013
- Drilling equipment and procedures since 2007 are consistent with industry standards and are adequate to support Mineral Resource estimation
- The quantity and quality of the lithological, recovery, collar and downhole survey data collected are consistent with industry standards and are adequate to support Mineral Resource estimation
- Due to the nature of the mineralization occurring as shoots and veins, the true width of the mineralization will vary both along strike and in the down dip direction. In areas where the strike and dip of the mineralization are well established, a true width for the mineralized intersection may be estimated. However, in areas of poor surface exposure or where there is no drilling or poor drilling, the true width of the mineralization cannot be estimated
- Sampling methods for core and underground samples are consistent with industry practices and adequate to support Mineral Resource estimation
- Sample preparation and analytical procedures since 2007 are consistent with typical industry practices at the time the samples were prepared, and are adequate to support Mineral Resource estimation
- Density determinations are acceptable to support Mineral Resource estimation
- Sample security procedures met industry standards at the time the samples were collected. Current sample storage procedures and storage areas are consistent with industry standards
- Data verification was undertaken in support of technical reports on the Project by external consultants SRK (2009), Chlumsky, Armbrust & Meyer, LLC (2009, 2010), Micon (2010) and Pincock, Allen and Holt (2012). These consultants concluded, at the time of their examination, that the data were suitable to support Mineral Resource estimation
- Data verification completed by external consultants in the period 2009–2012 indicated the data at the time of each review was suitable to support Mineral Resource estimates

- Wood audited collar survey, downhole survey, assays, density, lithology and redox tables. The data are considered acceptable to support Mineral Resource estimates.

25.5 Metallurgical Testwork

- Metallurgical testwork has identified six conceptual flowsheets that may have potential to treat mineralized material
- The currently preferred flowsheet is selective flotation to produce a concentrate followed by cyanidation of tailings to produce doré. Based on the composite samples tested to date, an overall average silver recovery of about 88% could be assumed to be achieved using this hybrid flowsheet
- Based on current testwork results, the concentrates that may be produced could contain arsenic, antimony and bismuth impurities, which could potentially result in higher concentrate treatment charges; the potentially elevated levels of arsenic in concentrate may incur a minor penalty charge
- Recovery variability is noted in testwork across the deposit from west to east, suggesting a change in silver mineralization that has yet to be identified. There also appears to be a change in hardness of the mineralized material (possibly associated with lower-grade material) that should be further investigated.

25.6 Mineral Resource Estimates

- Mineral Resource estimation was performed by Wood staff. Mineral Resources have an effective date of 26 February 2018. They have been estimated using the PACK methodology. Silver is the only commodity considered to have reasonable prospects of eventual economic extraction using a room-and-pillar underground mining method
- A number of factors were noted that may affect the Mineral Resource estimate, including: commodity price assumptions; changes in local interpretations of mineralization geometry and continuity of mineralization zones; changes to geotechnical, hydrogeological, and metallurgical recovery assumptions; density and domain assignments; changes to assumed mining method which may change block size and orientation assumptions used in the resource model; input factors used to assess reasonable prospects for eventual economic extraction; assumptions as to social, permitting and environmental conditions; and additional infill or step out drilling or results obtained from extending the exploration decline.

25.7 Conclusions

- Under the assumptions in this Report, Mineral Resources have been estimated for the Yaxtché deposit, assuming underground mining methods.

26.0 RECOMMENDATIONS

26.1 Introduction

Recommendations have been broken into two phases. Phase 1 recommendations are made in relation to database auditability, Mineral Resource estimation, and metallurgical testwork.

Recommendations proposed in Phase 2 are suggestions for additional data collection and data support for future mining studies.

The phases can be conducted concurrently, as Phase 2 is independent of Phase 1.

Phase 1 is estimated at about US$180,000 to US$235,000. Phase 2 is budgeted at approximately US$500,000 to US$750,000.

26.2 Phase 1

26.2.1 Database

The following recommendations are made in support of development of auditability trails for the database:

- Document which drill holes have had magnetic declination applied, and a record of where changes to original logging codes have been made as a result of the completed re-logging and redox re-coding campaigns
- Efforts should be made to locate the original total station survey records for the later drill holes, and ensure these are appropriately filed

This work is estimated at approximately US$5,000.

26.2.2 Mineral Resource Estimation

The following recommendations are made in support of Mineral Resource estimation:

- Oxide–sulphide data in the drill hole logs need additional work and documentation to better understand and improve the location of the oxide–sulphide boundary
- Additional PACK models should be constructed to better understand sensitivities of the mineralization to changes in commodity prices and changes in cut-off grades if alternative mining methods are selected to the envisaged room-and-pillar
- The dynamic anisotropy used to estimate the silver mineralization is generalized and may not reflect the local variability. The structural data used to define the dynamic anisotropy should be refined.

This work is estimated at about US$25,000 to US$30,000.

26.2.3 Metallurgy

The following recommendations are made in support of further metallurgical testwork:

- Additional mineralogical and geometallurgical studies and testwork are recommended to understand flotation and cyanidation recovery variability observed between the samples collected for historical testwork represented as west and the central and east zones. This will also help define geometallurgical zoning or domains more precisely relative to silver mineralogy and oxidation state and understand if flotation can be improved to reduce the need to consider cyanidation on the flotation tailings to maintain overall recoveries at acceptable levels
- Creation of geometallurgical domains should be investigated in conjunction with the geological and resource modelling disciplines. Recovery variability is noted in testwork across the deposit from west to east suggesting a change in silver mineralization that has yet to be identified. There also seems to be a change in mineralized material hardness, possibly associated with lower-grade material, that should be further investigated.

This work is estimated at US$150,000to US$200,000.

26.3 Phase 2

Yaxtché is a structurally-complex deposit and controls on the mineralization need to be studied to determine how to perform ore control during mining. A small portion of the mineralization was exposed during the development drift and the mineralization was difficult to follow. The following recommendations are made in support of future mining studies and refinement of the Mineral Resource model:

- The existing exploration decline that accesses the Yaxtché West domain should be extended to expose the higher-grade silver mineralization at depth. The extended decline will provide access to data and metallurgical samples at a bulk scale that cannot be collected at the scale of a drill sample
- A trial mining program should be undertaken to confirm that the conceptual room-and-pillar mining method is the most appropriate method for mining of the Yaxtché deposit in terms of costs, dilution, and mining recovery
- Ore control procedures should be developed on how to best delineate mineralized material and waste designed specifically for room-and-pillar mining methods, if that is the method selected. Changes to the mining method may result in changes to the block size selected, and the block orientations, and necessitate resource model changes/updates

- The resource estimate is based on selection of a 250 g/t Au silver threshold. The selection of the threshold value should be reviewed as part of mining scenario assessments. Other silver threshold cutoffs may be more applicable to mining alternatives other than room-and-pillar
- Metallurgical recovery is a single recovery, the data used to support the recovery should be reviewed to determine if the data are representative of the variability within the deposit
- The relative high variability in the SG values should be studied to determine if additional SG estimation domains should be developed.

This work is estimated at US$500,000 to US$750,000.

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