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CHINALCO MINING CORPORATION INTERNATIONAL

Competent Persons Report for Toromocho Copper Project

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Chinalco Mining Corporation International

REPORT

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Executive Summary

Golder Associates ("Golder") was commissioned by Chinalco Mining Corporation International (Chinalco) to prepare a Competent Persons Report to assist Chinalco in its Independent technical review of the principal assets of Minera Chinalco Perú (MCP). The project is located in Peruvian Andes approximately 140 km east of Lima. In August 2007 Chinalco acquired all the shares of Peru Copper Inc., owner of Minera Peru Copper, which is now Minera Chinalco Peru S.A, and on 5 May of the following year (2008) signed the transfer of concessions and mining assets contract of the Toromocho Copper Project.

The information, observations, and conclusions in this Competent Persons Report (CPR) that relate to Mineral Resource and Ore Reserve estimation and classification are provided in accordance with, and conform to the conventions of, the Australasian Code for Reporting of Exploration results, Mineral Resources and Ore Reserves (JORC Code, 2012 Edition). Dr Sia Khosrowshai reviewed the Mineral Resources for the Toromocho Copper Project. Mr Glenn Turnbull reviewed the Ore Reserves and applied modifying factors. Both Dr Khosrowshahi and Mr Turnbull are current Members of the Australasian Institute of Mining and Metallurgy (The AusIMM) and are competent persons in their respective fields under the JORC 2012 code. Mr Damian Connelly is a Principal Consulting Engineer with over 28 years' experience as a Consultant Metallurgist. Mr Connelly is a current Member of the Australasian Institute of Mining and Metallurgy (The AusIMM) and a competent person in his respective field.

The Mineral Resource and Ore Reserve estimates used in this report are information as at 31st December 2015. Chinalco has not advised Golder of any material change, or event likely to cause material change, to the Mineral Resource and Ore Reserve estimates.

The project commenced ore feed to the Crusher in December 2013 with copper concentrate being produced throughout 2014 and 2015. Tonnage build up within the process plant has been rapid with some 84% of design throughput having been achieved in 2015. The annual production metrics for the process plant for 2014 to 2015 are shown below (Table A).

Table A: Toromocho Project production statistics 2014-2016

	2014	2015	2016 (Estimate)
High Grade Mill Ore (Mt)	19.7	36.1	38.3
Low Grade Mill Ore (Mt)	1.1	0	2.7
Total Mill Ore (Mt)	20.8	36.1	41.0
Head Grade Cu (%)	0.562	0.538	0.604
Head Grade Ag (g/t)	7.31	6.416	5.416
Copper Recovery (%)	60	83.08	79.86
Recovered Metal (Cu Tonnes)	70,263	161,518	197,754
Concentrate Dry Tonnes	297,698	676,449	833,977
Arsenic Grade in conc. (%)	No Data	1.047	0.865

Although tonnage build up has been relatively satisfactory, the metallurgical recovery in 2016 has been lower than expected primarily because of issues with talc in the ore feed (Table B). The high Arsenic in concentrate has resulted in high penalty costs for treatment and refining costs. The molybdenum circuit has not been commissioned to date but is understood to be well advanced.

During 2016 the process plant has to date not achieved the expected recoveries and has been below expected throughput levels; it is however expected that the two are inter-related.

It would appear that the estimated recovery for 2016 might also be optimistic as average recoveries during 2016 for the first five months only equated to 72.96%. The lower throughputs noted by the process plant staff in terms of SAG mill performance appears to be directly related to the proportion of potassic material in the feed.

The potassic ore requires greater comminution effort in the initial phase (drilling and blasting) in order to ensure that the throughput at the SAG mill stage is not compromised. When blasting in the potassic material it is important to consider the overall total cost of operation to ensure that for example lower throughput does not result from a cost reduction in say drilling and blasting.

Table B: 2016 Actual performance January to May

Production 2016		Jan	Feb	March	April	May	YTD
Tons milled	DMT (kt)	2 770	2 230	2 401	2 973	3 064	13 439
Head Grade – Cu	%	0.61	0.51	0.58	0.60	0.64	0.59
Cu Recovery in Cu concentrate	%	73.63	77.03	73.08	72.22	70.61	72.96
Head Grade – Ag	g/t	6.14	6.90	5.98	7.22	7.13	6.70
Ag Recovery in Cu concentrate	%	59.71	69.40	64.97	58.96	55.59	61.03
Head Grade – Mo	%	0.01	0.01	0.01	0.01	0.01	0.01
Head Grade – Zn	%	0.09	0.10	0.11	0.09	0.14	0.11
Head Grade – As	%	0.03	0.04	0.03	0.04	0.03	0.03
Copper Concentrate Produced	DMT	55 693	40 232	52 658	68 881	72 382	289 847
Grade – Cu	%	22.26	21.82	19.43	18.55	19.15	20.03
Grade – Zn	%	3.23	4.47	3.65	2.79	3.83	3.53
Grade – As	%	0.82	1.20	0.83	0.92	0.65	0.86
Copper content	DMT	12 398	8 779	10 231	12 778	13 864	58 049

Of primary concern is the continuing issue with lower than expected recovery of copper. The copper will account for some 80% of the recoverable value from the project over the life of the mine and thus maximising the metallurgical recovery from the copper is vitally important. Ramp-up and commissioning has also coincided with a decline in copper prices that has resulted in significant financial pressure on the project. Total capital cost to date for the project has amounted to some $4B including finance charges.

In reviewing the Toromocho Project, Golder believes that the overall project remains technically sound, but has reservations about the ability of the project to deliver a satisfactory return on investment without the Expansion Option case. Taking the Toromocho Project as it stands today with a mill design throughput of some 42.8 Mtpa in all but the most optimistic pricing scenarios fails to meet a satisfactory level of financial return. Whilst the expanded case option, targeting some 62.0 Mtpa appears to be more financially attractive, it would seem unwise to commit to any further expansion currently until a full understanding of the talc recovery issues and future mitigation of arsenic levels in concentrate are better understood.

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1.0 LIMITATIONS

This Report has been prepared for Chinalco for the Toromocho Project by Golder Associates Pty Ltd (Golder) based on assumptions as identified throughout the text and upon information and data supplied by others.

The Report is to be read in the context of the methodology, procedures and techniques used, Golder's assumptions, and the circumstances and constraints under which the Report was written. The Report is to be read as a whole, and sections or parts thereof should therefore not be read or relied upon out of context.

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This disclaimer must accompany every copy of this Report, which is an integral document and must be read in its entirety.

2.0 INTRODUCTION

Golder Associates ("Golder") was commissioned by Chinalco Mining Corporation International (Chinalco) to prepare a Competent Persons Report to assist Chinalco in its Independent Technical Review of the principal assets of Minera Chinalco Perú (MCP). This report has focussed solely on the technical aspects of the Toromocho Mine and Processing Plant located in in the Peruvian Andes approximately 140 km East of Lima (Source: Google Maps

Figure 1).

In August 2007 Chinalco acquired all the shares of Peru Copper Inc., owner of Minera Peru Copper, which is now Minera Chinalco Peru S.A, and on 5 May of the following year (2008) signed the transfer of concessions and mining assets contract of the Toromocho Project.

Source: Google Maps

Figure 1: Toromocho Copper project in Peru

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2.1 Site visit

Golder employee Mr Glenn Turnbull (Principal Mining Engineer) made a site visit to the Toromocho project area from 26 to 27 July 2016.

Golder was given a detailed tour of the site by Mr Victor Astete including the mining operations, geological core shed, process plant facilities, and tailings dam.

During the site visit, Golder gathered and assessed the nature of information required to evaluate the appropriateness of the data, methodology, parameters, assumptions, approach used to for production and treatment purposes, and approach and methods used to estimate the Mineral Resources and Mineral Reserves.

The site visit observations are provided throughout this document. Most of the site visit observations in this document refer to current activities as opposed to the historical ones.

2.2 Conventions

Conclusions are presented throughout the text in ***bold italic font***.

Currency

All costs and prices are in US dollars (USD) unless otherwise specified.

Grid references

All grids are in local grid.

Block dimensions

Three-dimensional entities in this report are described in the format *x* by *y* by *z*, where *x* refers to the Easting, *y* refers to the Northing and *z* refers to the RL or vertical distance in metres based on elevations above mean sea level.

2.3 History

The earliest recorded information on the Toromocho deposit dates from 1928, when a low-grade ore zone was identified along the edge of the San Francisco peak monzonite stock and several other low-grade blocks were discovered. Further exploration was carried out by Cerro de Pasco until 1973-74, when the property was nationalised by the Peruvian government and transferred to Centromin.

During the 1970's, Centromin continued exploration, carried out a drilling program, and started small-scale exploitation of the Toromocho deposit in 1974. In the 1990's Centromin began the process of privatisation of all its assets. Exploitation by Centromin ceased in October 1997.

In 1999, J. David Lowell, one of the Founders of Peru Copper, began studying potential mineable deposits of copper ore reserves in Latin America. Through this process, in 2002, Mr Lowell determined that Centromin's Toromocho deposit had potential as a large open pitable operation. In April 2003, Peru Copper Syndicate was formed for the purpose of making a bid for the Toromocho mineral concessions.

Table 1 provides summary of the exploration history at Toromocho copper.

Table 1: Exploration history at Toromocho Copper

Year	Description
1928	A low-grade copper zone was identified along the edge of the San Francisco peak granodiorite stock.
1945-1955	Cerro de Pasco Corporation carried out an exploration program to evaluate the copper mineralisation.
1963	The area was further explored when Cerro de Pasco geologists confirmed that Toromocho had economic potential.
1966-1976	Extensive exploration continued with four campaigns conducted by the Cerro de Pasco Corporation and Centromin. These campaigns completed 143 drill holes for 42 394 m.
1974	Centromin started small-scale open pit exploitation of the Toromocho deposit. Total production was about 1.4 Mt at 1.0% Cu and 25 g Ag/t between 1974 until October 1997 when Centromin ceased exploitation.
1980	Centromin hired Kaiser Engineers International, Inc., and Consultores Minero Metalúrgicos S.A. to prepare a detailed feasibility study to confirm reserve estimates and determine key operational and economic criteria.
2003	The property was privatised and awarded to Chinalco Peru Copper (MC). Five of the Centromin holes were "twinned" by MPCopper, and the existence of a large copper deposit was confirmed.
2003-2007	MC had completed a total of about 271 holes totalling 109 879 m of infill, surface exploration, and underground diamond drilling. Metallurgical studies, mine planning, rock mechanic studies, geological modelling and resource estimation, hydrology, environmental, and community relations were begun during 2006 and 2007. Exploration drilling of the south-east and north-east extensions of the main ore body also began in 2007.
2011	MCPC drilled additional 10 diamond holes for total of 4298 m.

Year	Description
2015	MCPC conducted additional 45 diamond drilling in the area to increase the confidence and for verification of the historical data

MC has the right of indefinite exploitation (mining) concessions for the Toromocho deposit. Exploitation concessions allow the concession holder to mine the area indefinitely contingent upon the annual payment of corresponding license fees.

Concessions and surface rights for the general Toromocho area are illustrated on Figure 2. The Toromocho mineral concessions are held as an option agreement between MPCopper and Centromin.

Two larger companies holding property and mineral concessions adjacent to the Toromocho deposit and currently operating small underground mines are Pan American Silver and Austria Duvaz. Smaller companies holding concessions adjacent to Toromocho are Centenario, Pomatarea, Volcan, and Sacracancha.

MPCopper signed an agreement with Austria Duvaz, which granted the company an exclusive option to acquire their Morococha mining concessions, surface areas and assets of Austria Duvaz. In accordance with the share purchase agreement signed with Austria Duvaz, MPCopper gained 100% control of Minera Centenario and its stake in 30 concessions located in the Morococha mining district.

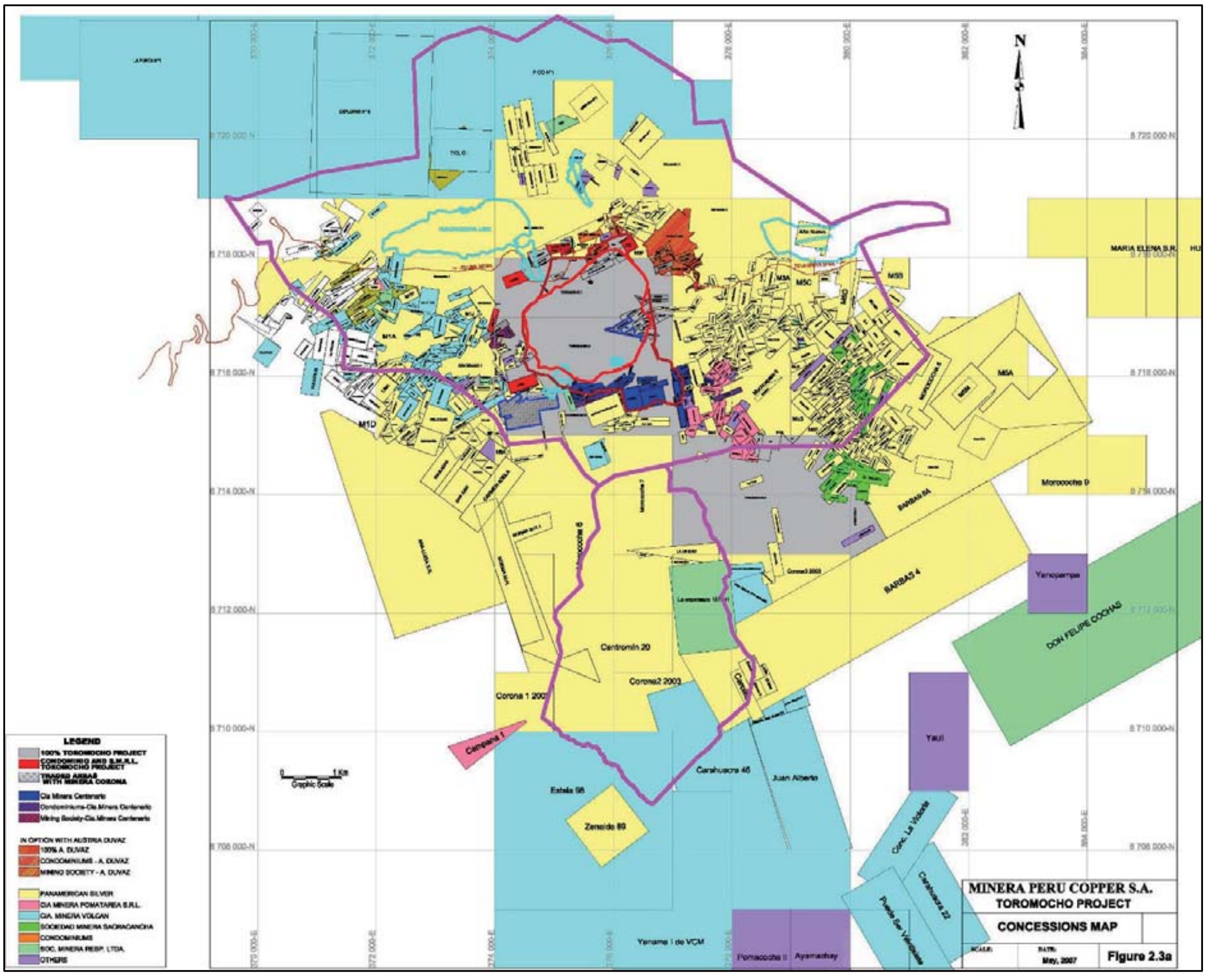


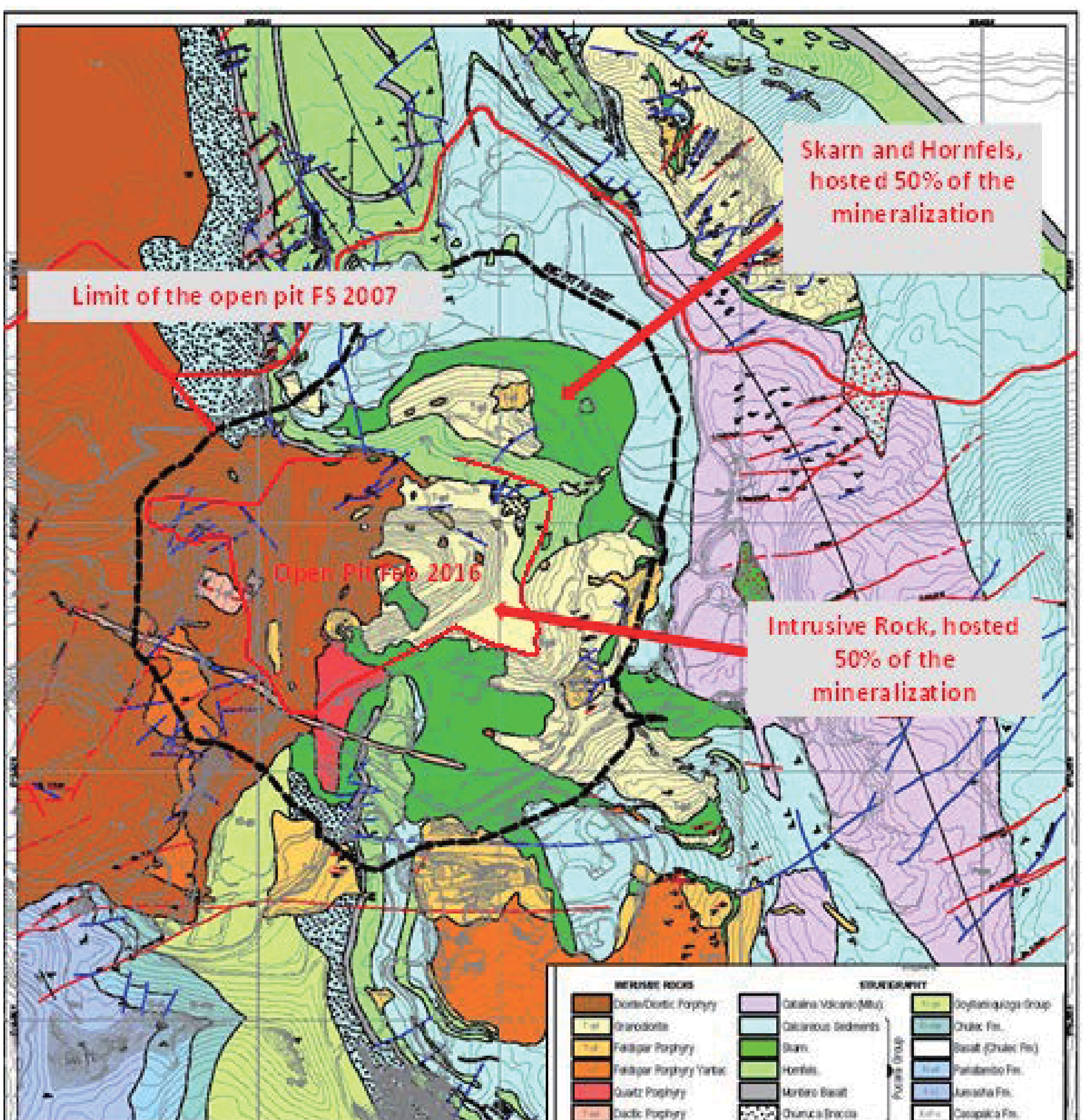
Figure 2: Tenure map

3.0 GEOLOGY AND RESOURCES

3.1 Geological setting

The 5 by 6 km Morococha district occupies a Tertiary intrusive centre with associated skarn, hornfels, and breccia mineralisation. It is developed in Jurassic Pucara calcareous sediments on the flat dipping (45-50°) western flank of a regional anticline located between a large, older, pre-mineral andesitic ("diorite") intrusive to the west, and Permian-Triassic (Catalina) volcanics to the east along the axis of the regional anticline.

The Toromocho ore body lies within the central copper zone of the well-zoned Cu/Pb-Zn/Pb-Ag polymetallic Morococha district. The ore body forms the center of a skarn and breccia associated with 7 million year old mineralisation, alteration, and granodiorite and porphyry intrusions.



(Source: TOROMOCHO GEOLOGY 2016_V01.pptx)

Figure 3: Geology of Toromocho and surrounding area

3.2 Mine geology

The Toromocho ore body outcrops on the surface. The copper ore body extends downwards to a flat "bottom" 500 to 600 m below the surface. The highest grade part of the ore body lies within a 1.0 km × 2.0 km body of brecciated skarn, surrounding a cupola-like 7 million year old feldspar porphyry and granodiorite intrusive, and underlies on the west side, the older regional andesitic/dioritic intrusive exposed on the surface.

The primary ore body is over-printed by late-stage, pyritic primary mineralisation, clay and serpentine alteration, and supergene chalcocite and covellite enrichment. Spotty and structurally controlled, moderate-to weak, chalcocite enrichment extends from the surface and from the top of dominant sulphides, downward to the bottom of enrichment, 200 to 400 m below the original topographic surface. A sulphate zone containing anhydrite disseminations and veinlets occur several hundred meters below the bottom of enrichment. A significant portion of the original leached capping above the enriched zone was probably stripped by Pleistocene glaciation. The upper half of the enriched zone in many places contains more than 50% leachable copper by sequential analyses. The lower half of the enrichment blanket above the bottom of enrichment and the top of the primary zone is generally only weakly enriched and contains from 15 to 50% leachable copper by sequential analysis.

3.2.1 Lithology

The main lithologic units that outcrop in the Morococha district are of both sedimentary and igneous nature, and their ages range from the Permian Period to the Tertiary Period.

The oldest rocks in the district belong to the Catalina Volcanics formation of the Mitu Group (Permian) and consist of lava flows of andesite to rhyolite composition, which occur with dacites, volcanic breccias, agglomerates, and tuffs located in the upper Mitu section.

Limestones of the Pucará Group (Jurassic) were deposited conformably on the Mitu (Catalina) disconformity (Proffett, 2005). In general, the Pucará sediments are comprised of light gray-to-white limestones, dolomitic limestone with interstratifications of shales, cherts, and sandstones; two lava flows are intercalated with the limestone, the Montero Basalt and the Sacracancha Trachyte. The Montero Basalt acts as a marker horizon and is near the top of the Pucará Group.

The massive anhydrite and gypsum at the bottom of the Pucará Limestone is comprised of layers of anhydrite, gypsum, shale, and limestone, lying over the volcanic rocks of the Catalina Formation in an apparent angular unconformity, and along the contacts of the feldspar porphyry, and granodiorite intrusions.

3.2.1.1 Tertiary intrusives

The wall rocks of the Toromocho deposit include several intrusive phases:

- **Anticona "Diorita"**: Exposed in the west and northwest of the Morococha district. It forms a flat bottomed "cap-rock" in the western part of the district where it overlies well-mineralised skarn.
- **Granodiorite:** The Morococha Granodiorite is an important host rock for mineralisation. It expands at depth and underlies, with a relatively flat upper contact, most of the Toromocho ore body.
- **Feldspar Porphyry**: The other important intrusive host rock for the mineralisation, and is possibly the most closely associated in time with the hydrothermal solutions that altered and mineralised the Toromocho ore body. It intrudes the diorite and granodiorite, and is intruded by the quartz porphyry.
- **Quartz Porphyry**: A younger intrusive found south-west of the main deposit.
- **Dacite Porphyry:** A single 20-30 m wide dyke of felsic porphyry containing numerous quartz eyes and quartz-feldspar aplitic groundmass trends NW-SE and crosses the entire south-western portion of the Morococha district. This dyke is a late feature and apparently post-dates all of the other Tertiary intrusions, and possibly most of the copper mineralisation.

3.2.1.2 Hornfels

Approximately one-half of the host rocks of the Toromocho ore body are the skarn and hornfel rocks.

- **Diopside Hornfels**: The calcareous sediments, which lack important argillic components, are commonly converted into diopside-quartz hornfels. Diopside hornfels and diopside-calcite rocks also appear to have developed from more pure carbonate layers, particularly in those having a significant content of original dolomite.

  Diopside-hornfels units consist of variable proportions of minerals, such as quartz, tremolite, plagioclase, epidote, and diopside, and commonly occur in units of calcareous shales. The mineralisation in these types of rocks is usually weak and limited to sparse pyrite-chalcopyrite veinlets and weak sulphide disseminations.

  The total percentage of sulphides in hornfels ranges from 1 to 2%; with sub equal Py/Cpy ratios. Copper values fluctuate between 0.3% and 0.6% in the secondarily enriched zone and from 0.1 to 0.3% in the primary zone.

- **Wollastonite Hornfels:** White jasperoidal hornfels are present in the northern part of the district and are composed mainly of wollastonite and quartz, most likely derived from calcareous sandstones.

- **Biotite Hornfels:** In the central zone, the biotite hornfels have a microgranoblastic texture composed of variable aggregates of plagioclase, potassium feldspar, quartz and biotite. Overprinting alteration to sericite and/or chlorite may be present. The sulphides are disseminated, replacing biotite altered to chlorite. Small type "B" quartz veins with Py-molybdenite may also be present. The average total content of sulphides is about 1 percent in volume and the Py/Cpy ratio varies from 3:1 to sub-equal. Copper content ranges from 0.05 to 0.15% and up to 0.06% Mo.

3.2.1.3 Skarns

The main types of skarn within the Toromocho ore body are tremolite/actinolite skarn, massive magnetite skarn, "serpentine" altered skarn, and endoskarns at the contacts with intrusives.

- **Tremolite Actinolite Skarn:** The main minerals in the early skarn rocks are garnet tremolite and actinolite. Veinlets of quartz, chalcopyrite – pyrite, or chalcopyrite without or low in pyrite with actinolite halos, are common and apparently contemporaneous with potassic biotite potassium feldspar alteration in the intrusives.

  Hydrous calcium and magnesium silicates, sulphides, and carbonates replace the anhydrous calcium and magnesium silicates predominant in hornfels by later skarn alteration.

  Mineralised structures in the skarns include small, discontinuous, and shallow veins, and rich sulphide mantos following the stratification. In general, these orebodies are small, irregular, clustered, and a very irregular local replacement of the skarn host rocks.

  The massive sulphide mineralisation in the veins and mantos structures are usually Py-Cpy-magnetite; in some cases, accompanied by marmatitegalena-pyrrhotite. Secondary chalcocite, when present, enhances the grade of all of these ores.

- **Magnetite Skarns:** Magnetite rich skarns occur especially in serpentised skarn derived from original dolomitic strata. A variety of high magnesium minerals are present in the serpentised skarn in variable proportions including: talc, antigorite, phlogopite, lizardite, and chlorite. Locally, forsterite olivine also has been identified**.**

- **Endoskarn:** Some of the skarn formed in and near the contacts of intrusives is an endoskarn. It preferentially develops in granodiorite and is characterized by garnets, pyroxenes, and tremolite and actinolite replacing with complete destruction of the igneous texture of the intrusives. Total sulphides range from 1 to 5%, with copper grades often above 1% Cu.

3.2.2 Structure and mineralisation

In the Morococha District the major structure is Morococha anticline, an asymmetric fold with the axis of the anticline running at a strike of N20°W south of the district, and N40°W to the north of the district, plunging between 10 and 15° to the north. There are two secondary anticlines along the east and west flanks of the Morococha anticline, respectively (Figure 4).

At least two important reverse faults are noted parallel to the general strike of the sedimentary rocks. These faults are the west-dipping “Potosi” fault on the east flank of the north-west portion of the anticline; and the east-dipping “Gertrudis” fault on the west flank (Figures 3.4a, 3.4b and 3.5c). The dip of the two reverse faults varies between 45 and 70° and is opposed.

A number of other faulting shears of interest including the Huachamachay and the San Gerardo Faults in the central eastern part of the ore district and the San Antonio 2 and 8 Vein faults.

There are several relatively small mineralised polymict and monomict hydrothermal breccias in the Pucará sediments. These breccias are generally located along reverse fault zones or along their projections, as well as along the disconformity between the limestone and the Catalina Volcanics, and along the contacts of the Morococha intrusives or Montero basalt.

These breccias appear to be relatively late and pyritic.

Mineralisation is split approximately equally between two main lithology groups of Tertiary intrusives and Meta-sediments.

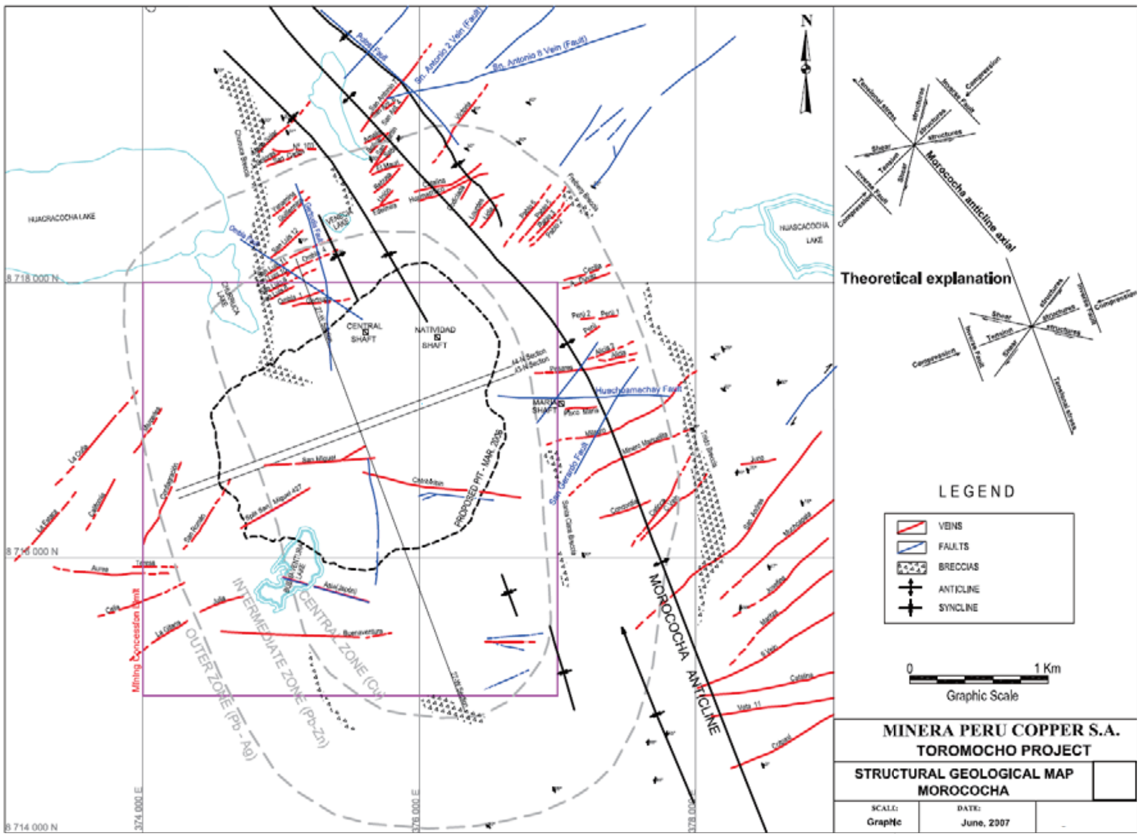
The most abundant primary ore minerals in the deposit are chalcopyrite, tetrahedrite, enargite, sphalerite and galena and occur in three main forms.

- **Veins:** The strongest mineralised veins were emplaced along tension fractures. The shear faults, with abundant gangue were only weakly mineralised, making small ore shoots. Tension fractures and veins are well developed in the intrusive rocks. These are relatively continuous in length and depth, with generally uniform mineralisation. The veins in skarns and hornfels are less continuous and generally do not extend to depth. These are irregular in thickness and grade, and tend to form horse-tail structures along contacts with granodiorite and feldspar porphyry. The veins have been formed chiefly by fracture filling, but in skarn host rocks formed by both filling and irregular replacements of the skarn wall rocks.
- **Mantos (massive sulphide) and Clustered Orebodies:** In general, the mantos are irregular and both follow and cross-cut the stratification. The clustered orebodies are small, very irregular, and located chiefly along the hanging wall of major veins. These orebodies are the horizontal extensions of the veins along the stratification, with local irregular replacements of the adjacent wall rocks.
- **Contact Orebodies:** These orebodies are irregular and have been formed by replacement of the skarn. The mineralisation is mainly finely disseminated but also massive, and in coarse pods. The adjacent granodiorite and feldspar porphyry can also contain finely-disseminated mineralisation.

3.2.3 Alteration

Several overall classes of mineralisation alternations are noted as follows:

- **Early low pyrite potassic alteration:** The bulk of the original primary copper mineralisation is in the form of disseminations and stockworks of chalcopyrite, low or lacking in pyrite, and often deposited with abundant magnetite. “A” type quartz veins are scarce in the Toromocho intrusives. “B” type quartz veins with selvages and sutures containing molybdenite are more common. Open cavities in the matrix of the intrusives and within the “B” veins are very common and represent the sites of original anhydrite, leached by later supergene solutions.



(Source: Figure 3.5c of Feasibility document 2007)

Figure 4: Structural geology map at Toromocho Copper

- **Early tremolite/actinolite skarn alterations:** The limestone and dolomites of the Pucará Formation were converted to anhydrous quartz and anhydrite-bearing wollastonite and diopside hornfels, and the shales to biotite/potassium feldspar hornfels by the intrusion of the Upper Tertiary San Francisco stock.

  Little to no copper was probably deposited during the time of hornfels development. Chalcopyrite mineralisation in the hornfels is mainly in the form of relatively-sparse chalcopyrite veinlets with dark green actinolite halos. There is indication of a close timing of potassic and actinolite alteration. Close spaced stockworks and pervasive replacement of diopsidic hornfels by tremolite/actinolite produced skarns containing relatively high-grade chalcopyrite mineralisation.

- **Late pyritc overprinting:** Chalcopyrite-bearing biotitic EDM-type veinlets in intrusives are systematically cut by pyritic "D" type veinlets with sericitic halos. The quartz porphyry intrusive is pervasively sericitized and contains pyritic mineralisation. Chalcopyrite/actinolite veinlets in skarns and hornfels are also consistently cut by later pyritic veinlets with soft "clay-like" halos of chloritic and serpentine-type alterations.

- **Serpentine altered skarn:** About one half of the tremolite/actinolite skarn contains variable amounts of soft clay-like "serpentine altered skarn". The serpentine alteration contains variable combinations of high magnesium minerals such as talc, clinochlore, phlogopite, antigorite, and lizardite, and probably is a retrograde-type of alteration associated with the pyritic overprinting mentioned above, and in some skarns, magnetite formation. The occurrence of talc in the "serpentine–altered" skarn is important metallurgically. It readily floats with molybdenite and is more difficult to depress than the other "serpentine" minerals. Clinochlore and phlogopite appear to be the most consistently associated with talc of the serpentine minerals.

- **Anhydrite:** A large percentage of the total sulphur originally deposited in the Toromocho primary sulphide ore body was deposited in the form of anhydrite. A deep "sulphate zone" has been identified. Anhydrite alteration and mineralisation spanned the evolution of the primary ore body from early potassic alteration and skarn formation to late serpentine alteration of skarn and pyritic overprinting, and to late vein and manto formation. The "top of sulphates" is formed by the hydration and solution of anhydrite and gypsum by circulating groundwater.

  Ground conditions below the "top of sulphates" differ significantly from those above the "top of sulphates". In the sulphate zone, RQD values are consistently higher (generally above 90) in both the intrusives and skarns. All rocks within the sulphate zone are impermeable and porosity is zero, due to impregnation by anhydrite disseminations and sealed anhydrite veinlets and fractures.

  Therefore, the top of sulphates also will control mine water by acting as an impermeable barrier in underground workings and/or on pit benches.

3.2.4 Enrichment and metal zoning

Several types of enrichment and metal zoning are noted as follows:

- **Copper enrichment:** Supergene leaching and enrichment processes have developed a chalcocite enrichment zone at Toromocho which extends irregularly to 400 m below the surface. Compared to other secondarily enriched porphyry copper deposits, such as El Salvador, Escondida, and Chuquicamata in Chile, chalcocite enrichment at Toromocho is relatively weak, spotty, and discontinuous, except locally and where concentrated along structures.

- **Silver Enrichment:** The silver content of the ore may be secondarily enriched from about 5 g/t in the primary zone to about 6 to 7 g/t in the enriched zone. At least some of the silver in the enriched zone could be present as acanthite (argentite), which is difficult to distinguish from chalcocite during logging. However, the higher silver values in the upper parts of the enriched zone could also be due to hypogene vertical zoning of primary silver minerals, such as tetrahedrite and tennantite.

- **Arsenic:** The highest arsenic values are concentrated in structural zones within the strongly enriched intrusives. Arsenic values in the primary zone are only about 130 ppm. Intermediate values of 200 to 500 ppm are present in the weakly-enriched zone in between. It is likely, however, that these arsenic patterns reflect mainly hypogene zoning of late enargite/tennantite mineralisation upwards as previously described.

- **MgO and Fluorine:** MgO is considered as a problematic element in the concentrate which not only attracts heavy penalty fines but also depending on the form in which it occurs may adversely impact the copper recovery. Material with which the MgO has association is talc with up to 32% MgO, phlogopite with up to 28% MgO and 4.5% fluorine and chlorites that may contain up to 8.3% MgO.

3.2.5 Summary

Geology of the Toromocho Deposit is complex and with a high degree of variability. Copper is in primary sulphide and skarn material. Skarn represents 50% of the material that contain copper mineralisation. High percentage of fluorine and MgO has been noted with skarn ores as alterations in form of talc, phlogopite and chlorites that are considered as problematic at the time of floatation in both reducing copper recovery and causing high concentration of MgO and fluorine in the concentrate that attracts undesirable heavy penalties.

3.3 Drilling data

The information contained in this section is sourced from IMC (2007) and Golder (2016).

3.3.1 Drilling

Overview

Drilling has occurred at the Toromocho deposit since 1966 with the most recent drilling completed in 2015. Drilling has been by three primary organisations – Cerro de Pasco Corporation (CdP) and Centromin (1966 to 1976), Peru Copper Incorporated (PCI) (2003 to 2012), and Chinalco (2015) (Table 2).

All drilling to date is by diamond drilling techniques and of the total 496 drill holes, eight have no information. The 2016 Resource Model used approximately 154 km of drill hole data that have assays for total copper (TCu). Drill holes are distributed on a 60 m × 60 m semi regular grid (Figure 5).

The CdP and PCI holes are located on an exploration drill grid that is rotated about 23° counter clockwise from UTM with collar locations recorded on this local grid system until about 2007. Since then all collar coordinates have been surveyed in the PSAD56/UTM Zone 18S coordinate system and pre-2007 drillhole locations converted to the same grid. The original exploration grid rotation is evident on the drill hole location map (Figure 5).

Table 2: Toromocho drilling campaigns

Company	Year	No. Drill holes		Metres
CdP/Centromin	1966	4	125	1 415.77
	1967	24		8 542.00
	1970	24		4 850.53
	1971	14		2 394.69
	1974	20		6 632.87
	1975	38		14 577.22
	1976	1		391.97
Peru Copper Inc.	2003	5	318	1 879.80
	2004	81		39 485.30
	2005	107		49 352.95
	2006	29		6 659.90
	2007	69		22 715.90
	2008	13		5 289.25
	2011	12		5 004.25
	2012	2		615.80
Chinalco	2015	45	45	10 808.45
No information		8	8	1 295.00
Total			**496**	**181 911.65**

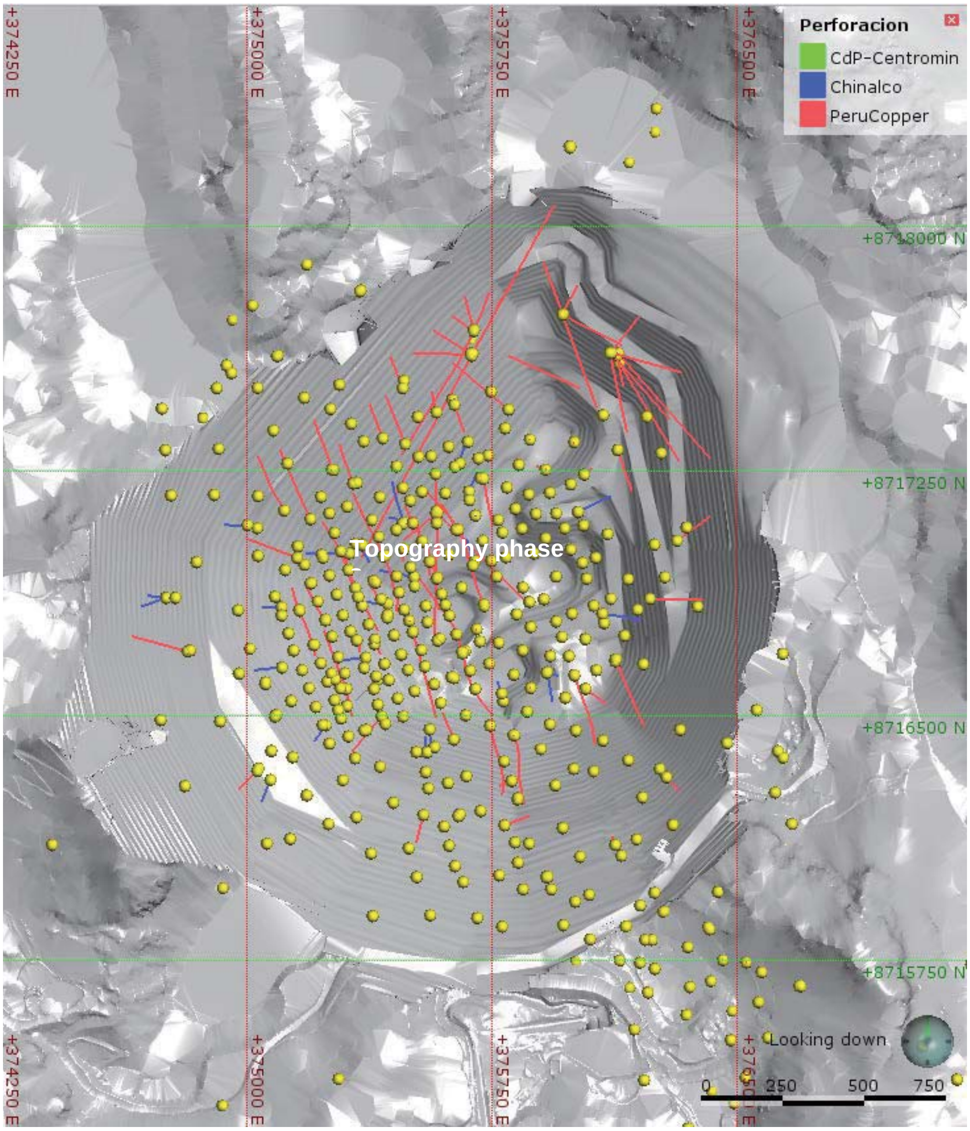


Figure 5: Toromocho drill hole locations

CdP and Centromin drilling

The CdP holes are generally on a 100-120 m spaced drill grid with more infill drilling in the central area of the deposit. Historic information available (IMC, 2007) indicates that all of the CdP holes are diamond drill holes of various diameters from BX to NX (42-55 mm diameter). In 2007, PCI undertook a comprehensive review of the CdP drilling data and results are discussed in Section 3.4.

All drillholes are vertical and Golder has no knowledge whether CdP undertook downhole surveying. There is no record of the method for surveying collar locations.

Given the amount of verification drilling in future drilling campaigns, Golder does not consider these items to have a significant effect on the estimation of Mineral Resources.

PCI drilling

The PCI holes drilled during 2003 through 2007 were generally HQ core (63.5 mm diameter), recovered with face discharge bits and split inner barrels. Every effort was made to maximise core recovery. A few PCI holes are PQ diameter for metallurgical sample purposes.

Golder has no knowledge of the methods PCI used for downhole surveying. Survey of collar locations is likely similar to Chinalco procedures, but Golder has not sighted documentation about the specific equipment or survey procedures.

Golder does not consider these items to have a significant effect on the estimation of Mineral Resources for Toromocho.

Chinalco drilling

In 2015 Chinalco completed an infill drilling campaign consisting of 45 Diamond Drill holes. All drill holes are HQ diameter and were drilled with a LF-90D rig.

Survey of drill hole collar coordinates was with a high-resolution GPS system brand TOPCOM series GR5 All collars are surveyed in the PSAD56 system.

The drill hole deviation survey was measured using a gyroscope operated by Geotecnia Perú. Measurements are every 6 m downhole.

3.3.2 Core recovery and core logging

CdP and Centromin

PCI personnel obtained paper logs for 130 of the CdP holes from the Centromin archives. Those logs included about 27 000 copper and 19 00 molybdenum assay results out of nearly 28 000 intervals.

Sample weight information was also available for the 27 000 intervals. Core recovery was variable in the CdP holes with average core recoveries reported as 80%.

Split core is still available for many of the CdP holes and PCI personnel were able to relog 97 holes with the procedures currently used by PCI and Chinalco.

PCI

PCI diamond drill holes are logged for geotechnical and geological information prior to core splitting. A summary log is first developed for the drill hole with basic contact information of rock types. Later, a detailed geological log was completed for the drill holes with rock type, alteration, and observed sulphide mineralogy.

Chinalco

Logging processes and codes are the same as those used by PCI.

Drill hole recovery was calculated by summing the length of individual core pieces (DDH) and expressing that as a percentage of the total interval. For any given lithological unit, recoveries average over 90%, with the exception of drilling in unconsolidated gravels. There are no significant variations on recovery between geological units.

3.3.3 Sampling

CdP and Centromin

The precise procedures for splitting and sampling of the CdP holes are not known. PCI re-assayed many old 10 m pulp composites as a check on the old methods and results are discussed in Section 3.4.

Sample lengths for the CdP holes generally average round 1.30 m in length although they vary significantly. Many shorter intervals are apparent in the CdP holes. PCI believed these were likely a function of drilling problems rather than an effort to match geological contacts (IMC, 2007). Core was split with half the core going to assay and the other half retained in the core tray.

PCI and Chinalco

PCI and Chinalco have similar procedures for sampling core ((from IMC, 2007)

Figure 6).

The initially sampling is been completed under the control of company personnel. The core is split by diamond sawing at the core shed in Tuctu located about 3 km from Toromocho. The core handling procedures at site are generally as follows:

- HQ and PQ Core is boxed in wooden boxes at the drill rig
- The core is transported to the core logging facility at Tuctu
- The core is washed and photographed
- Geotechnical logging is completed on whole core
- Geological logging is completed on the whole core
- The core is dry sawn lengthwise
- Half core is retained at the core shed at Tuctu.
- Half core is sent to CIMM Peru S.A. in Lima for sample preparation and assay
- The Split core is transported to the sample prep lab by company personnel.

Sample interval lengths for the PCI and Chinalco holes are generally 1.50 to 1.55 m in length corresponding to a 5 foot drill run. No effort is made to break the sample at geological contacts.

3.3.4 Sample preparation

CdP and Centromin

The current understanding of the CdP procedures is as follows:

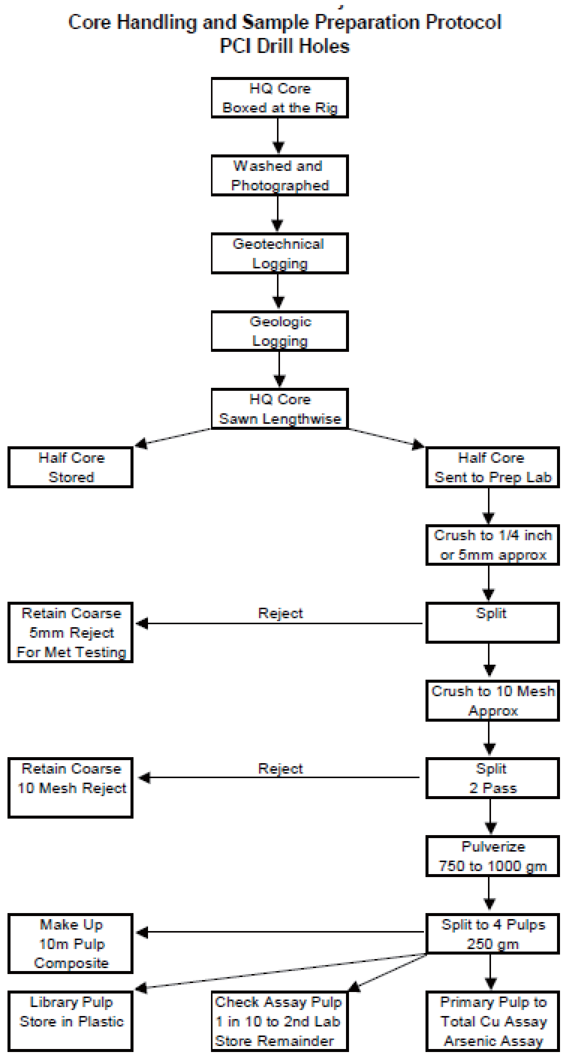
- CdP holes were split with half the core going to assay and the other half retained in the core tray.
- The split core was reduced to pulps before assaying for total copper. Occasional assays for zinc, molybdenum, and “oxide copper” were also recorded.
- Pulps of representative weight were combined to form a single pulp representing a 10 m bench interval. There is no documentation about the procedures used to make up the pulp weight composites.

PCI and Chinalco

- The sample preparation and handling of the PCI and Chinalco holes have been under the control of company personnel or their contractor lab CIMM Peru S.A. (CIMM) in Lima.
- The core handling through sawing is completed by company personnel at Tuctu. The half core is then transported to the CIMM sample preparation and assay lab in Lima by company personnel.
- The sample preparation is completed by CIMM under contract to the company ((from IMC, 2007)
- Figure 6).
- During a visit to CIMM facilities, IMC (2007) reported:

  “Proper cleaning and maintenance of sample preparation equipment is practiced by the CIMM lab. IMC personnel have not visited a sample preparation facility that is as clean and well organised as the CIMM facilities.”

- Samples are dried at 100°C for 6 to 8 hours upon arrival at CIMM. They are then crushed in a jaw crusher to nominally 90% passing ¼ inch (5 to 6 mm). Barren quartz is run between samples to clean the jaws of the crusher. The unit is also cleaned with compressed air between samples with an air injection lid on the crusher. A dust collection system is installed to minimised airborne contamination dust. All sizing units at CIMM are installed with a dust collection system.
- The sample is then split with a riffle splitter and the coarse reject saved for future use.
- The other half of the split is roll crushed to 90% passing 10 mesh. A second riffle split is completed in two passes in order to retain about 1000 g for pulverising. Pulverising is completed in one of two units – an LM2 or an LM5 pulveriser. Internal laboratory quality controls screen 2% of pulps to assure that the pulps average 96 to 98% passing 150 mesh.
- The pulps are blended and split into four pulps of about 250 g each. One of the pulps is assayed for copper and arsenic. Composites of the pulps are used to make up a composite pulp that represents a 10 m bench interval. These are developed by precise weighing of each of the component pulps in the same ratio as the component of the drill sample within the 10 m interval. The composites are assayed sequentially for copper and other elements as outlined in Section 3.3.5).
- Coarse rejects at minus 10 mesh and back up pulp samples are stored on site.



(from IMC, 2007)

Figure 6: Toromocho core handling and sample preparation protocol

3.3.5 Assaying

CdP and Centromin

The total copper assay procedure for CdP holes was reportedly the short iodide method, which is understood to be a titration process.

PCI was able to find many of the original CdP pulp 10 m weight composites and sent them for re-assay at the CIMM laboratory in Lima. Results suggest that the CdP holes overestimate copper grade in the less than 0.20% copper range (Section 3.4). The titration chemistry that seeks the copper ion will instead report the Fe++ ion when copper values are low and Fe values are high. This situation certainly occurs in the leach cap environment at Toromocho (IMC, 2007).

PCI and Chinalco

As mentioned above, PCI and Chinalco use the independent commercial laboratory Cimm Peru S.A. located in Lima as the primary lab for assays. Check assays are completed at ALS Chemex.

The CIMM Peru S.A. and ALS Chemex labs have been awarded ISO-9002 certification. The CIMM lab also has accreditation NTP-ISO/IEC 17025 from Indecopi.

Every interval was assayed at CIMM for total copper and additional metals as shown in Table 3.

The total copper assay procedure at CIMM is an aqua regia digestion followed by atomic absorption spectroscopy (AAS) analysis. Acid soluble assays are based on a nominal room temperature sulphuric acid dissolution, followed by AAS. The acid soluble rejects are rinsed, dried, and dissolved in cyanide solution followed by AAS to estimate the amount of chalcocite and other cyanide soluble species.

Samples for AAS at CIMM are prepared in batches or trays holding 50 samples. Within each tray there are: one commercial standard, one blank, and three duplicates. The internal lab QAQC analysis of the standards, blanks, and duplicates are available on request for review.

IPC, up to 2007, also sent one out of every 10 pulps out for external assay at ALS Chemex assay laboratory. IMC (2007) analysed the results of these check assays and found them to be proper confirmation (Section 3.4).

Table 3: Analytical methods for Toromocho

Element	Digestion	Detection Limit	Method
Tcu	Multi-acid digestion	< 0.001%	AAS
Scu	5% H_2SO_4 (0.002-10%)	< 0.002%	AAS
Scu	10% NaCN (0.002-10%)	< 0.002%	AAS
Rcu	Residual Cu (0.001-10%)	< 0.001%	AAS
Ag	Multi-acid digestion	< 0.3 g/t	AAS
Mo	Multi-acid digestion	< 0.0005%	AAS
As	Multi-acid digestion	< 0.001%	AAS
Zn	Multi-acid digestion	< 0.001%	AAS
Fe	Multi-acid digestion – HF, $HClO_4$, HNO_3 y HCl	< 0.01%	AAS
S(t)	Total Sulphides (Based on ASTM E 1915-09 a 2009)	< 0.01%	CIS
Multi-element	Multi-acid digestion – HF, $HClO_4$, HNO_3 y HCl	-	ICP-OES

3.3.6 Conclusions

The drilling, sampling, sample preparation schemes, and analytical techniques are considered appropriate and to industry standard.

3.4 Quality assurance and quality control (QAQC)

Quality Assurance (QA) is the system and set of procedures used to ensure that the sampling and assay results are of high quality. Quality Control (QC) is the data used to prove the results of sample preparation and chemical analysis are adequate.

To monitor the quality of the sample preparation process and geochemical analysis, complete QAQC procedures require the use of:

- Standard Samples, both Certified Reference Material (CRM) and Internal Reference Material (IRM)
- Blank pulp samples
- Cross laboratory check samples
- Duplicate samples from various stages of sample preparation submitted.

Toromocho has undergone a number of drill phases (see Section 3.3) with varying degrees of QAQC measures in place. PCI and Chinalco have both included validation programmes of the historical drilling, sampling, and analytical quality. The results of these are discussed below.

Golder has relied on information presented in IMC (2007) and Golder (2016) for assessment of QAQC data. Information presented in the following sections are sourced from these reports.

3.4.1 QAQC for historical CdP/Centromin drilling (1966 to 1976)

There is no evidence of any QAQC programmes in place for the CdP drilling, sampling, and analyses. Verification of CdP drilling has been primarily by a comprehensive programme by PCI. Information and results presented here are from IMC, 2007.

The testing and validation of CdP drilling by PCI included:

- Comparing calculated CdP drilling 10 m Composites to CdP drilling weighted assays to establish the validity of the CdP pulp weight compositing process.
- Comparing CdP Pulp Weight Assays to re-assays by CIMM of CdP Pulp Weight Composites to establish the validity of CdP Weight Assays.
- A nearest neighbour (NN) Comparison of CdP vs PCI Drilling.

3.4.1.1 Standard samples

No evidence of the use of standard samples. Assay accuracy was checked through the use of duplicate pulp analyses by PCI (Section 3.4.1.4).

3.4.1.2 Blank pulps

No evidence of the use of blank pulps have been recorded for the historical data.

3.4.1.3 Duplicates

No evidence of the use of duplicate samples have been recorded for the historical data.

3.4.1.4 Repeats

No evidence of the use of repeat assays have been recorded for the historical data.

3.4.1.5 10 m bench samples

CdP started the process of preparing pulp weight composites to represent 10 m intervals by combining carefully weighed pulps from individual assay intervals. IMC, 2007 checked the validity of the pulp weight process by calculating 10 m composites based on the individual assays for each sample interval (Figure 7).

IMC 2007 concluded:

- Copper shows a minor bias in that the pulp weight composites have lost some metal (2%) on average.
- Molybdenum shows no bias between methods, but does display more variance in the pulp weight composites than in the calculated assays.
- Results for both metals indicate that there is no bias in the pulp weight process.

CdP Calculated Composites from Assays vs CdP Pulp Weight Composites (Old Holes)							
Metal	Number Composites	Calculated Mean Grd	Pulp Wt Mean Grd	T-Test of Means	Paired T	Binomial Test	KS Distribution Test
Copper %	3797	0.423	0.415	Pass	Fail	Fail	Pass
Moly%	2719	0.012	0.012	Pass	Fail	Fail	Fail

(from IMC, 2007)

Figure 7: Statistical analysis of CdP 10 m pulp weighted assays against calculated composites

3.4.1.6 Laboratory assay checks

PCI personnel were able to find the pulps for about 52% of the pulp weight composites for the CdP drill holes. These pulps were sent to the CIMM laboratory in Lima for re-assay using the same methods applied to the PCI and Chinalco drilling (Section 3.3.5).

IMC, 2007 concluded from an analysis of results (Figure 8):

- Historical CdP silver and arsenic values cannot be repeated with reliability and should not be used for resource estimation. The re-assays by CIMM could however be used when available for silver and arsenic.
- The observed variability in the molybdenum analysis lead IMC to the conclusion that historic molybdenum assays were not reliable and that the CIMM re-assays of the old pulps should be the only use of historic data for molybdenum.
- Zinc and copper results show that the historic information could be used.
- CdP assay information could be used if no other data was available for copper, zinc, and lead. No CdP data could be used for molybdenum, silver, arsenic, or gold.

CdP Pulp Weight Assay vs Cimm Reassay of Old Pulp Weight Composites							
Metal	Number Composites	Original Mean Grd	Cimm Mean Grd	T-Test of Means	Paired T	Binomial Test	KS Distribution Test
Copper %	2012	0.377	0.382	Pass	Pass	Pass	Pass
Moly%	1822	0.013	0.012	Pass	Pass	Fail	Fail
Silver gm/t	2012	8.379	6.597	Fail	Fail	Fail	Fail
Arsenic %	1743	0.046	0.026	Fail	Fail	Fail	Fail
Zinc %	2012	0.145	0.143	Pass	Pass	Fail	Fail

(from IMC, 2007)

Figure 8: Statistical analysis of re-assays of CdP 10 m pulp weighted assays

3.4.1.7 Twin hole analysis

IMC, 2007 completed a comparison between closely spaced composites of CdP and PCI holes. The 10 m composites were paired so that CdP composites that were within 10 m of PCI hole composites were compared. The overall purpose was to determine if the CdP samples had any bias relative to nearby PCI holes once assay differences had been evaluated.

After completing a series of statistical tests, IMC, 2007 concluded CdP data could be used with PCI data, but observed some variability between individual paired data.

Nearest Neighbor, PCI Composties vs Old Hole Composites, Best Assay Selection								
Metal	Separation Dist Mtr	Number Composites	PCI Mean Grd	Old Hole Mean Grd	T-Test of Means	Paired T	Binomial Test	KS Distribution Test
Copper %	10	301	0.553	0.545	Pass	Pass	Pass	Pass
Moly%	10	84	0.010	0.009	Pass	Fail	Pass	Pass
Silver gm/t	10	84	5.298	6.054	Pass	Pass	Pass	Fail
Arsenic %	10	84	0.029	0.036	Pass	Pass	Fail	Fail
Zinc %	10	301	0.148	0.043	Pass	Pass	Fail	Fail
Lead %	10	94	0.015	0.023	Pass	Pass	Fail	Fail
Gold gm/t	10	84	0.016	0.015	Pass	Pass	Pass	Fail
	Paired Samples below the Leached Surface				95% Confidence Criteria			

(from IMC, 2007)

Figure 9: Statistical analysis of paired CdP and PCI drilling data

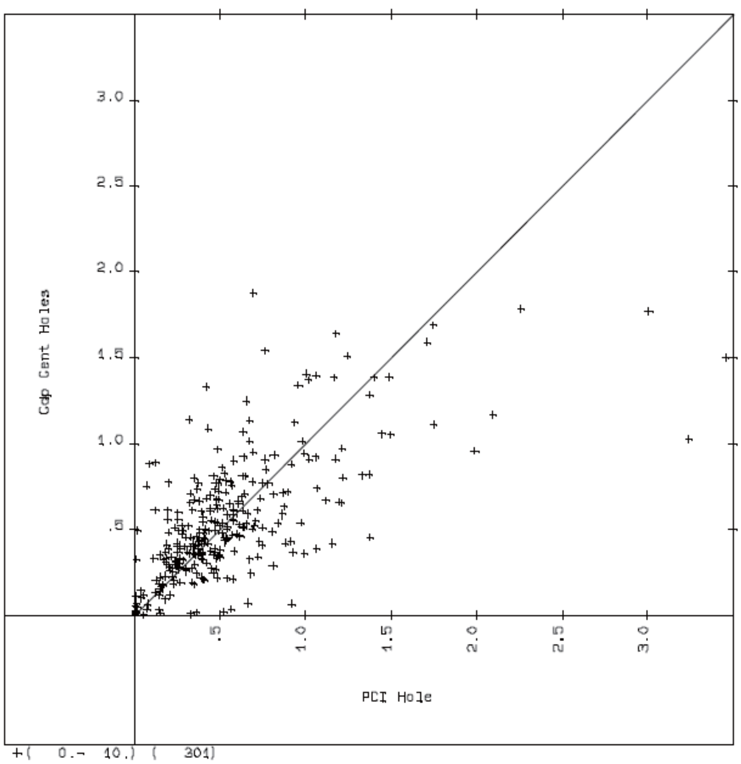


Figure 3-7
Nearest Neighbor Comparison
Total Copper, 10m Spacing
PCI vs Old Hole Composites

PCI Avg Cu = 0.553%
Old Avg Cu = 0.545%

XY Plot

(from IMC, 2007)

Figure 10: Paired TCu data from CdP and PCI drilling

3.4.2 QAQC for PCI drilling (2003 to 2012)

Information and results presented here are from IMC, 2007. The analysis covers drilling undertaken from 2003 to 2007. According to Golder, 2016 PCI did not have the same QAQC protocols for chemical analysis.

Golder undertook repeat assays of approximately 10% of the PCI samples assayed after 2007 (Section 3.4.2.6).

The QAQC by PCI included:

- Comparing CIMM Assays with Chemex and SGS check assays on pulps to establish the validity of CIMM assays
- Comparing calculated 10 m composites with 10 m Pulp Weight Composite assays to establish the validity of the Pulp Weight Composite process.

3.4.2.1 Standard samples

No evidence of the use of standard samples. Assay accuracy was checked through the use of repeat pulp analyses by Chinalco (Section 3.4.2.4).

3.4.2.2 Blank pulps

No evidence of the use of blank pulps have been recorded for PCI data.

3.4.2.3 Duplicates

No evidence of the use of duplicate samples have been recorded for PCI data.

3.4.2.4 Repeats

As stated above, Golder, 2016 states that PCI did not have QAQC protocols for chemical analysis. In order to verify that the data did not have problems of accuracy or precision and is suitable for estimation purposes, a set of pulps representative of those campaigns were selected and sent to CIMM laboratory for chemical analysis with the inclusion of control samples.

From a total of 10 340 pulps available, which represent approximately 80% of the total, 1 296 pulps were selected (approximately 10%) and sent for chemical analysis with standards, pulp blanks and duplicates.

Golder, 2016 reported:

- No issues with QAQC samples (standards and pulp blanks) submitted with batches to CIMM.
- Repeat analyses are within acceptable limits for CuT, Ag, Mo, Zn, and As.

3.4.2.5 10 m bench samples

PCI calculated composites vs PCI pulp weight composites

PCI prepared pulp weight composites to represent 10 m intervals by combining carefully weighed pulps from individual assay intervals. In order to check the validity of the pulp weight process, 10 m composites were calculated by IMC based on the individual assays for each sample interval (IMC, 2007). The results of the statistical hypothesis tests are summarised below:

IMC, 2007 concluded:

- The majority of metals show good correlation between the calculated composites and the pulp weighted composites (Figure 11).
- Molybdenum does not indicate a bias between pulp weight and calculated composites, but it does show increased variability compared with some of the other metals.
- It is appropriate to use the pulp weight composites for molybdenum if there are insufficient interval assays to use the calculated composites. If, however, there are sufficient interval assays to establish a calculated composite, it should get priority.
- Calculated composites should be used whenever possible due to the larger mass of assay support from the calculated composites. Pulp weight composites will be used when there are insufficient interval assays for a calculated composite.

PCI Calculated Composites from Assays vs PCI Pulp Weight Composites							
Metal	Number Composites	Calculated Mean Grd	Pulp Wt Mean Grd	T-Test of Means	Paired T	Binomial Test	KS Distribution Test
Copper %	9318	0.425	0.426	Pass	Pass	Pass	Pass
Moly%	863	0.003	0.003	Pass	Pass	Fail	Fail
Silver gm/t	887	5.465	5.420	Pass	Pass	Fail	Pass
Arsenic %	400	0.024	0.024	Pass	Pass	Pass	Pass
Lead %	615	0.036	0.033	Pass	Pass	Fail	Fail
Zinc%	864	0.237	0.235	Pass	Pass	Fail	Pass

(from IMC, 2007)

Figure 11: Statistical analysis by IMC, 2007 of calculated 10 m composites with pulp weighted composites

3.4.2.6 Laboratory assay checks

PCI routinely sent 1 out of every 10 pulps to outside laboratories for check assay. Most of the check assays were completed at ALS Chemex. However, during April through July 2005, outside checks were completed at the SGS Laboratories.

IMC, 2007 conducted a number of statistical hypothesis tests comparing the check assays versus the original CIMM assays (Figure 12) and concluded:

- Statistical tests and scatter plots for copper, molybdenum, and silver confirm the assay results from CIMM check well with ALS Chemex results.
- Arsenic results indicate that two values reported as 1% from Chemex were originally reported as values of about 0.1 and 0.3% from CIMM. These two outliers are suspicious results from Chemex. The positive T test and Paired-T results for the arsenic do not indicate an arsenic assay issue at CIMM.
- IMC has formed the opinion that the check assays are a reasonable validation of the CIMM assays on the PCI drilling to 2007.

Check Assay Results, Statistical Hypothesis Tests Results at 95% Confidence Level								
Metal	Number of Checks	CIMM Mean Grd	ALS-Chemex Mean Grd	SGS Mean Grd	T-Test of Means	Paired T	Binomial Test	KS Distribution Test
Copper %	5327	0.439	0.431		Pass	Fail	Fail	Pass
	1362	0.344		0.352	Pass	Fail	Fail	Pass
Moly%	649	0.007	0.006		Pass	Fail	Pass	Fail
	147	0.040		0.040	Pass	Pass	Pass	Pass
Silver	1135	8.513	8.446		Pass	Pass	Fail	Fail
	147	4.254		3.757	Pass	Fail	Fail	Fail
Arsenic	297	0.026	0.031		Pass	Pass	Fail	Fail
	147	0.008		0.009	Pass	Fail	Pass	Fail
Lead	966	0.052	0.05		Pass	Fail	Fail	Fail
Zinc	1114	0.245	0.248		Pass	Pass	Fail	Pass

(from IMC, 2007)

Figure 12: Statistical analysis comparing assays from CIMM and Chemex

3.4.2.7 Twin hole analysis

No evidence of the use of twin hole analysis have been recorded for PCI data other than nearest neighbour checks of CdP samples (Section 3.4.1.7).

3.4.3 QAQC for Chinalco drilling (2015)

Information and results presented here are from Golder, 2016. The analysis covers drilling undertaken during 2015.

Chinalco has a comprehensive QAQC protocol. Total QAQC samples submitted with 2015 drill sample batches is shown in Table 4. Acceptance criteria for the QA is:

- Field Duplicates, maximum of 10% of pairs with relative difference greater than 30%.
- Coarse Duplicates, maximum of 10% of pairs with relative difference greater than 20%.
- Pulp Duplicates, maximum of 10% of pairs with relative difference greater than 10%.
- Pulp Blanks, 3 times the detection limit
- Coarse Blanks, 5 times the detection limit
- Standards, results within ±3 standard deviation of the expected value.

Table 4: Quality control sample of 2015 campaign

Control Type	Code	No. Samples
Field Duplicate	FD	201
Coarse Duplicate	CD	201
Pulp Duplicate	PD	201
Coarse Blank	CB	202
Pulp Blank	PB	200
TCu Low Grade Standard	BDCH-01	198
TCu Middle Grade Standard	MDCH-02	141
TCu High Grade Standard	ADCH-03	62

3.4.3.1 Standard samples

Standards were constructed during 2015 by OREOS with material from the Toromocho deposit. Standards were included to determine accuracy of assaying by CIMM for the 2015 drilling programme.

TCu results for standards did not detected samples outside the acceptance criteria (Table 5). An example of the control chart for BDCH-01 is provided in Figure 13.

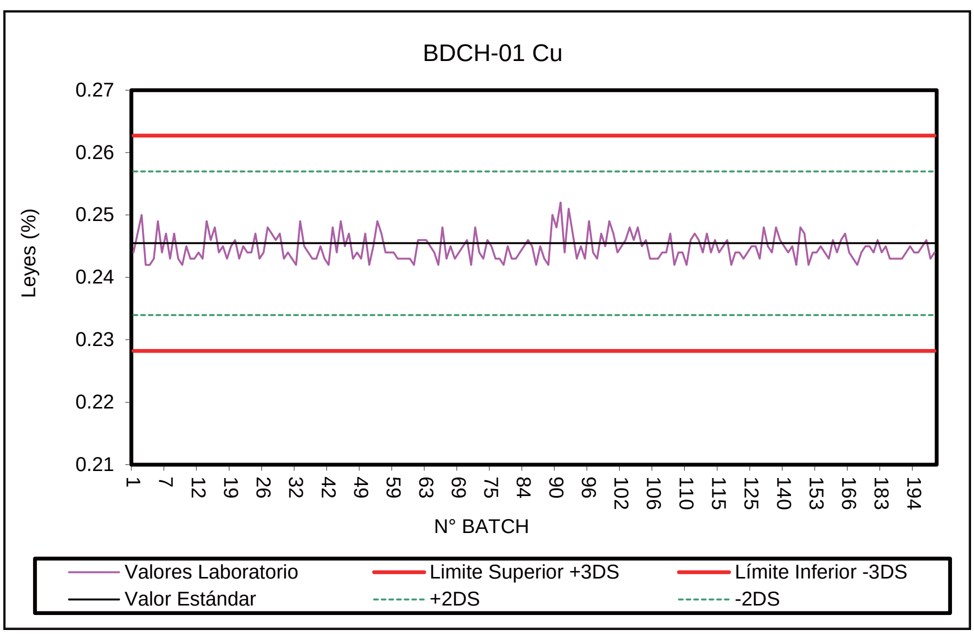
Golder noted that in general results were within acceptance ranges of internal procedures and are considered acceptable.

Table 5: Standard results 2015 drilling campaign

Standard	Element	Expected Value		# of Samples	Assay Value		Analysis			Acceptance Value	
		Ave	Std. Dev.		Ave	Std. Dev.	Bias % [a]	CV %	# Outlier	Min (-3DE)	Max (+3DE)
BDCH-01	CuT (%)	0.25	0.01	198	0.24	0.002	0.0	0.01	0	0.23	0.26
MDCH-02	CuT (%)	0.43	0.01	141	0.43	0.003	0.4	0.01	0	0.41	0.44
ADCH-03	CuT (%)	0.93	0.03	62	0.94	0.007	0.6	0.01	0	0.84	1.02
BDCH-01	Ag (g/t)	2.37	0.16	198	2.30	0.164	-3.1	0.07	2	1.88	2.86
MDCH-02	Ag (g/t)	2.92	0.31	141	2.80	0.156	-4.2	0.06	0	1.98	3.86

Standard	Element	Expected Value		# of Samples	Assay Value		Analysis			Acceptance Value	
		Ave	Std. Dev.		Ave	Std. Dev.	Bias % [a]	CV %	# Outlier	Min (-3DE)	Max (+3DE)
ADCH-03		23.73	1.16	62	23.89	0.428	0.7	0.02	0	20.24	27.22
BDCH-01	Mo (ppm)	59.31	2.24	198	57.98	1.260	-2.2	0.02	0	52.59	66.02
MDCH-02		86.8	3.92	141	88.92	6.860	2.4	0.05	1	75.05	98.55
ADCH-03		135.17	8.43	62	141.24	3.640	4.5	0.03	0	109.87	160.47
BDCH-01	As (ppm)	49.8	9.57	198	39.60	3.610	-20.5	0.09	0	21.09	78.50
MDCH-02		187.58	11.23	141	176.52	14.240	-5.9	0.08	1	153.90	221.26
ADCH-03		1045.81	52.57	62	1041.61	135.270	-0.4	0.13	1	888.12	1203.51
BDCH-01	Zn (ppm)	61.35	2.95	198	61.97	3.990	1.0	0.06	0	52.51	70.19
MDCH-02		339.35	12.02	141	336.52	45.060	-0.8	0.13	1	303.29	375.40
ADCH-03		6392.43	96.48	62	6178.55	53.000	-3.3	0.01	5	6103.00	6681.87

(from Golder 2016).



(from Golder 2016)

Figure 13: Example control chart of TCu results for Standard BDCH-01

3.4.3.2 Blank pulps

Chinalco submits coarse blank and pulp blanks to monitor for contamination through the sample comminution circuit.

Results of analysis of all blank samples (Table 6) show all samples returned without evidence of contamination.

Table 6: Coarse blank and pulp blank results 2015 drilling campaign

	CuT %	
	Coarse Blank	**Pulp Blank**
Detection Limit (LD)	0.001	0.001
Limit: 5 LD	0.005	0.003
Number samples	202	200
Minimum	0.0005	0.001
Maximum	0.002	0.002
Average	0.001	0.001
Median	0.001	0.001
% Outside limit	0%	0%

(from Golder 2016).

3.4.3.3 *Duplicates*

As described above, Chinalco duplicate samples from different stages of the sample comminution process. For the 2015 programme just over 200 duplicate samples were submitted (Table 7). Sampling precision is acceptable for all duplicate processes, except the field duplicate results show some outliers.

Table 7: Duplicates results for TCu from 2015 drilling campaign

Type	Campaign	No. Assays	Average HRD%	Average HARD %
Field Duplicate	2015	201	-1.49	11.09
Coarse Duplicate		201	0.18	1.46
Pulp Duplicate		201	0.24	0.93

(from Golder 2016).

3.4.3.4 *Repeats*

No evidence of any repeat assay checks on 2015 drilling data.

3.4.3.5 *10 m bench samples*

No evidence of any QAQC on 10 m weighted pulp composites.

3.4.3.6 *Laboratory assay checks*

No evidence of any laboratory assay checks on 2015 drilling data.

3.4.3.7 *Twin hole analysis*

No evidence of the use of twin hole analysis have been recorded against 2015 drilling.

3.4.4 Conclusions

In the absence of historical QAQC data, analysis by IMC (IMC, 2007) appears to verify the quality of the historical drilling data.

There are no standards data to support any of the CdP and PIC results. As such there is some risk attached to the quality of this data.

The QAQC program for the Chinalco drilling appears to be extensive with both qualitative and quantitative approaches.

Golder considers that overall the QAQC results are acceptable and support the use of the data for inclusion in the Mineral Resource estimation.

Recommendation: Field duplicate analyses for the 2015 drill programme show some outlier data resulting in an average HARD% of a little over 11%. A review of the sampling protocols is recommended to improve precision of sampling.

3.5 Density

There are a number of sources of density measurements available:

- Density data recorded by CdP and Centromin amounting to 27072 density measurements (Old Holes) prior to MC acquisition.
- 38 MC samples sent to CIMM for density determinations without wax to 2007.
- 88 MC samples sent to CIMM for density determinations with wax.
- 24 MC core samples sent to Call and Nicholas (CNI) for rock strength testing had density values measured.
- Density measurements since 2007 carried out core samples every 15 m.

The density data for the CdP were individual core samples weighed in air and weighed in water without any coatings prior to immersion in water. The 38 sample sent to CIMM were also weighed in air and weighed in water without coating prior to immersion. The 88 sample sent to CIMM did include a paraffin coating prior to immersion with appropriate back calculation and removal of the paraffin density from the rock density determination.

All other density data since 2007 were carried on core samples taken every 15 m by selecting 10 cm of cores that are considered as representative of the geology of the interval. Density measures consider the wax immersion methodology. 5% of the density samples are sent to a second laboratory as part of the QAQC program. Results of the QAQC indicate no major issues.

Density database includes a total of 26 758 measurements distributed as shown in Figure 14.

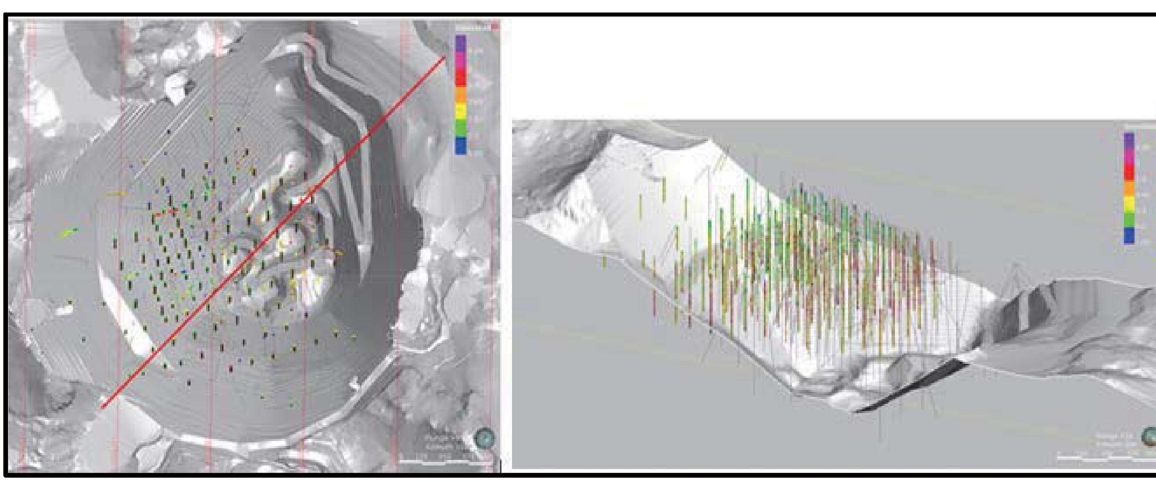


Figure 14: Distribution of density samples

3.6 Geological modelling

The geological modelling was carried out by MC and used by Golder, involved in interpretation and modelling of: lithology, alteration and mineral zones. Golder Associates S.A. carried out the estimation of grades and density. All the work was done under the supervision of Toromocho staff, and reviewed and validated by this Golder Competent Person.

The database was reviewed for inconsistencies, and no significant errors, such as overlaps or gaps intervals, were detected.

Both Chinalco and Golder reviewed the geological model and verified its robustness by a visual review and comparing the model against the original geological information using a back-flagging test.

The geological modelling methodology considered an on screen interpretation with Leapfrog Geo®. The lithology, mineral zone and alteration model followed the following procedure:

- Definition geological sequence for each variable
- Interpretation of vertical sections
- Interpolation and construction of three-dimensional model.

Table 8 details the geological codes and the grouping for model construction for the estimation units for TCu.

Table 8: Geological codes and grouping

Lithology

Group	Cod	Abrev	Description
Intrusive	1	Dior	Diorite
Intrusive	2	Gran	Granodiorite
Intrusive	3	Feld	Feldspar Porphyry
Intrusive	4	Qtz	Quartz Porphyry
Intrusive	5	Dac	Dacitic Porphyry
Intrusive	6	Ynt	Yantac Porphyry
Horn fels	10	Horn	Hornfels
Skar n	11	Skn	Skarn
Skar n	12	Magsk	Magnetite Skarn
Sedimentary- Volcanic	13	Bslt	Montero Basalt
Sedimentary- Volcanic	14	Sed	Calcareous Sediment
Sedimentary- Volcanic	15	Shl	Shale
Sedimentary- Volcanic	16	Vol	Andesite
Sedimentary- Volcanic	17	Anh	Anhidrite
Sedimentary- Volcanic	18	Ss	Sandstone
O by	100	Coll	Colluvial

Alteration

Group	Cod	Abrev	Description
Intrusive	2	Pot	Potassic
Intrusive	3	Prop	Propylitic
Intrusive	4	Seric	Sericitic
Intrusive	5	Arg	Argilic
Intrusive	6	Silic	Silicification
Intrusive	7	End Sk	Endoskarn (diop+gam)
Intrusive	7	End Sk	Endoskarn (act-trem)
Skarn	9	Trem- Act	Green alteration
Skarn	10	Serp	Soft Greenish
Skarn	11	Grt- Diop	Gamet- dioside
Skarn	18	Mg	Magnetite
Horn fels	12	Diop	Diopside
Horn fels	12	Bio- Qz	Biotite+ Qz
Sedimenta ry	15	Qz- Woll	Qz+ Wollastonit
Sedimenta ry	15	Marb	Marblized
Sedimenta ry	17	Shale	Shale
Sedimenta ry	19	Ss	Sandstone
O by	100	Coll	Colluvial

Mineral Zone

Group	Cod	Abrev	Description
Li x	1	Leach	Leached
Secundary	2	Enrich	Stong- Moderate Cc Enrichment
Secundary	4	Weak	Weak Cc Enrichment
Primary	5	Prim	Primary
Primary	6	Sulphate	Anhydrite
O by	0	Coll	Colluvial

In order to confine the estimation to volumes with enough samples and to avoid excessive extrapolation, a Geological Information Limit (GIL) was also created, see Figure 15. The GIL was constructed in Leapfrog and defined considering a distance of 150 m from the farther sample with the distance measured in the horizontal or from the bottom of the drill hole.

Figure 16 provides plan view example of the lithology, alteration, Minz and geological information limit through 4400 m RL with composite data location shown. A cross section example of the same has been provided in Figure 17. The section line trace is marked on Figure 16.

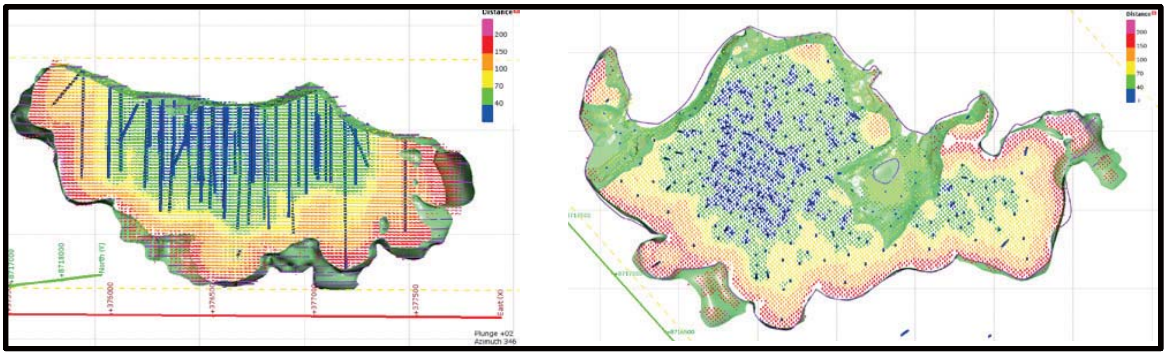


Figure 15: Limit of geological information

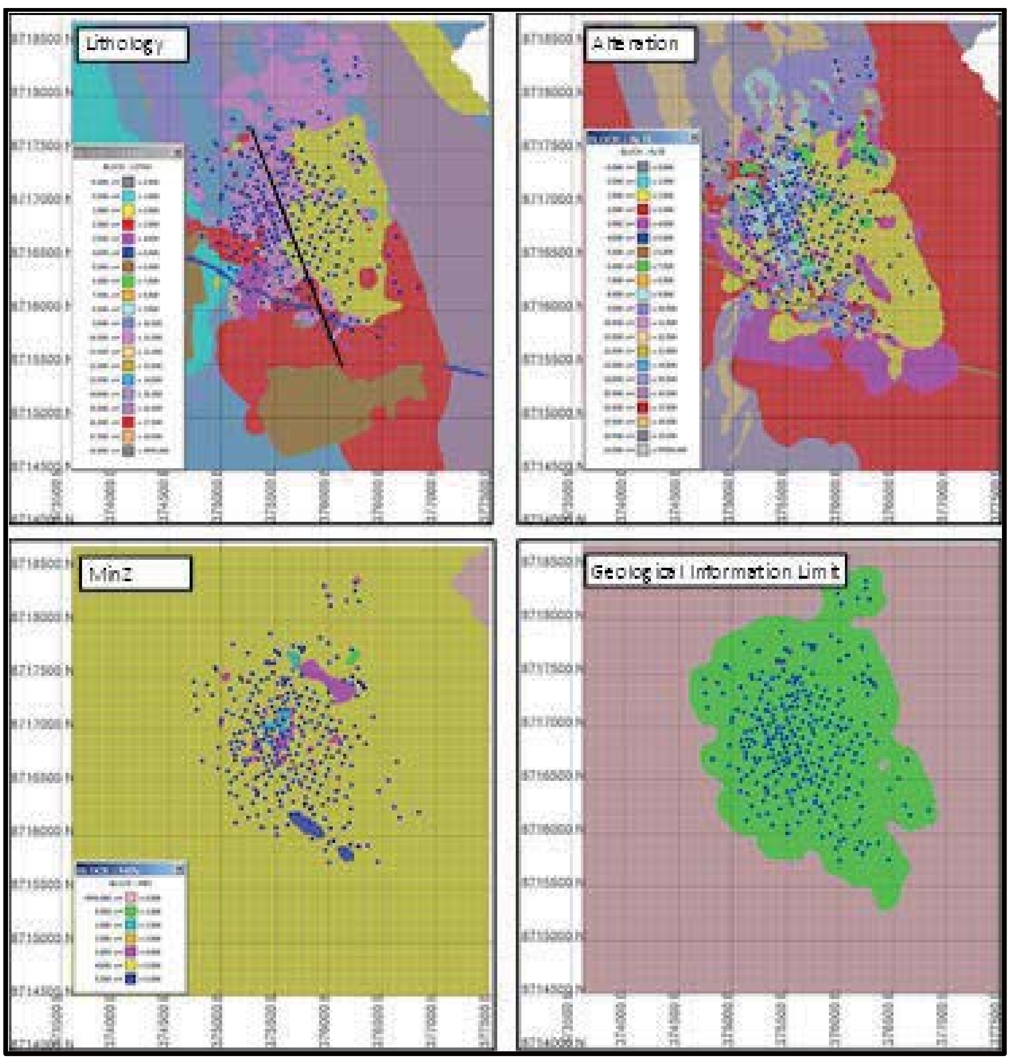
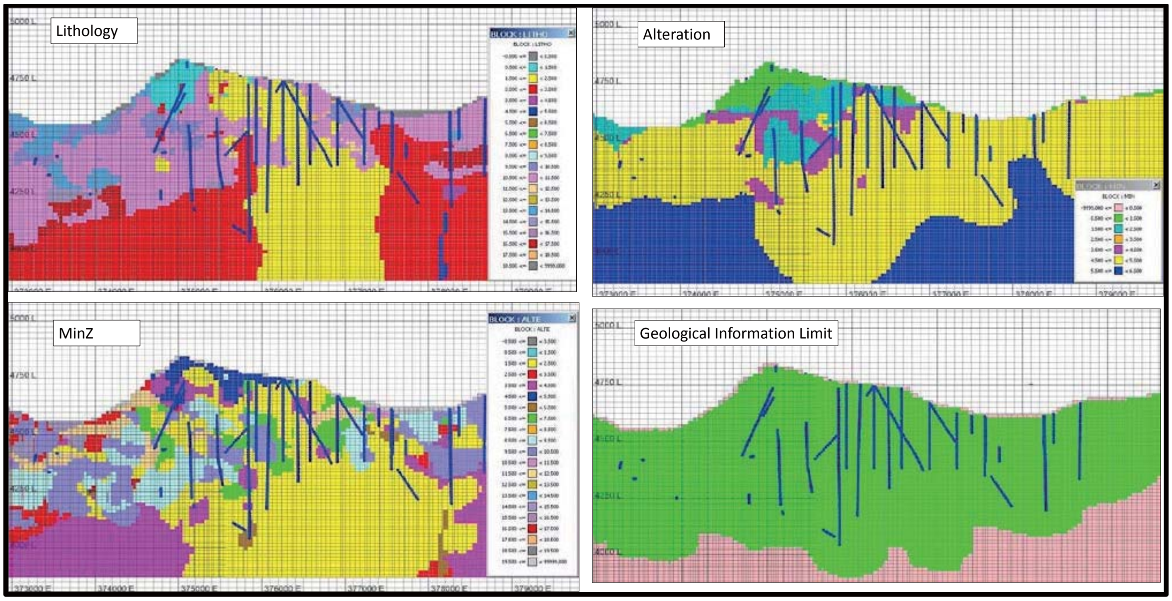


Figure 16: Plan view of block model lithology, alteration, Minz and geological information through 4400 m RL with composite data



Cross section trace is provided in the previous plot

Figure 17: Cross section view of the block model lithology, alteration, Minz and geological information with composite data location marked

3.7 Estimation databases

3.7.1 Data sources

The drillhole database used by Golder for the 2016 Mineral Resource estimation is combination of the historical drillhole data to 2003 (366 holes) and that drilled since 2003 (130 holes). Table 9 provides a summary.

Golder downloaded raw data, composite files and block model from the designated Intralink site as listed in Table 9 respectively. Golder converted and imported the data in to Vulcan software for this review.

Table 9: Summary of data used for mineral resource estimation

Variables	CuT	Mo	Ag	Zn	As	Pb	Au
Metres drilled	17 767.74	76 417.58	58 542.65	56 396.2	18 692.75	41 254.05	34 380.2
No. Samples	11 898	50 717	39 034	37 602	12 544	27 502	22 919
Historical Data	1.5 m	10 m bench	10 m bench	10 m bench	10 m bench	10 m bench	10 m bench
New Data	1.5 m	1.5 m	1.5 m	1.5 m	1.5 m	1.5 m	1.5 m
Variables	**Cuas**	**Cuascn**					
metros	128 258.51	128 258.51					
No. Samples	12 177	12 177					
Historical Data	10 m bench	10 m bench					
New Data	15 m	15 m					

3.7.2 Compositing

For the historical data (pre 2003), with the exception of CuT% assays, all other elements have used a 10 m bench height samples. CuT% has a consistent sampling length of 1.5 m.

For compositing purposes therefore a 4.5 m composite length was used for CuT% and 10.5 m for all other elements. For sequential coppers, the database was compiled in both original length, historical (10 m) and new drill length (15 m).

The resource estimates are based on a 4.5 m composite size. A compromised 10.5 m composite length was chosen for all other elements.

The majority of raw assays for CuT% data are equal or less than 1.5 m support (98% of assays) with the remaining 2% on irregular intervals between 1.5 m and 7 m (see Figure 18).

Considering a vertical block size of 15 m, a 4.5 m composite size for CuT% assays on angled holes is reasonable and also it provides sufficient resolution during estimation. Given the historical 10 m bench composites of minor elements against the recent 1.5 m length data, the 10.5 m composite length is considered as a fair compromise.

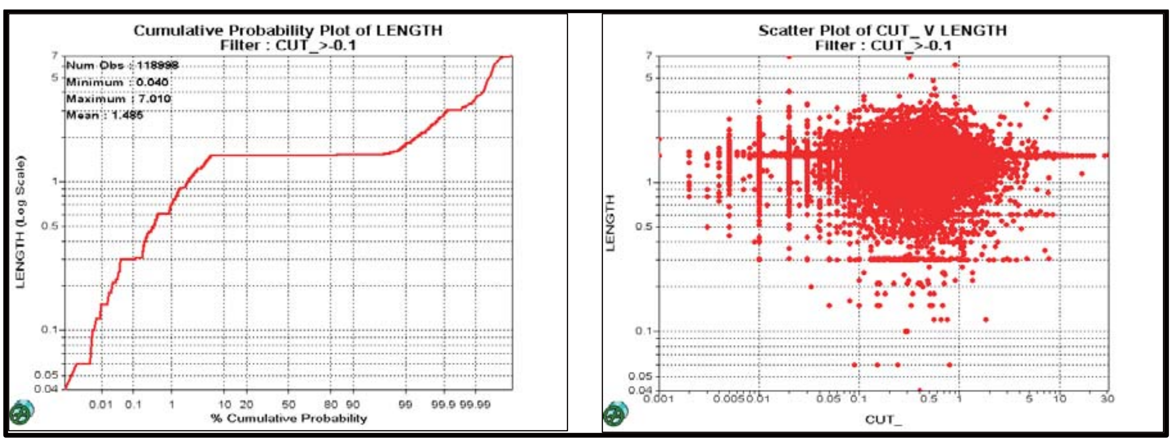


Figure 18: Left-Cumulative probability plot of raw assay lengths, Right-raw assay length Vs CuT%

3.7.3 Estimation domains

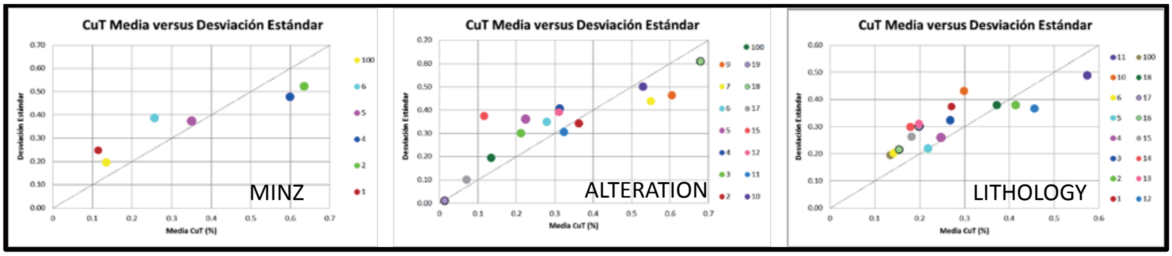
Estimation domains were investigated using various statistical approaches including cumulative log probability plots, scatter plots, histograms and descriptive univariate statistics. The details on procedures and results of various estimation domains has been provided in report "*149 215 1105IT017_revB.docx dated June 2016*".

Estimation domains and subsequent statistical analysis, variography and kriging estimation has been carried out on a number of elements including CuT%, soluble copper elements (CuAS and CUASCN), Ag g/t, Au g/t, Mo%, Zn%, Pb%, As% and Density.

The following sections provide a summary extract of the approach and results on key elements only, including CuT%, Ag g/t, Zn%, As% and Density.

3.7.3.1 CuT%

Figure 19 provides scatter plot of mean vs standard deviation for each of the Minz, Alteration and Lithology groups. A strong control is noted with Minz followed by a further secondary control imposed by alteration and then by lithology.



Minz (left); Alteration (middle); Lithology (right)

Figure 19: Mean vs standard deviation of CuT% composite assays

Further analysis of log cumulative probability distributions attributed to each of the individual Minz provides the following insight.

- Leached profile: Two populations are noted to be associated with alteration and no specific pattern arising from Lithology. The Alteration related populations are Endoskarn, skarn and hornfels as one group and other alterations as a second group.
- Strong and weak enrichments (Minz 2 & 4) were initially considered as a combined group as the statistics based on Minz appeared similar. However further checks based on alteration and lithology combinations showed that such combination can only be sustained for Intrusive Endoskarn plus skarn alterations and where material is defined as skarn or Mg skarn by lithology as two distinct estimation groups.
- The remainder of the strong and weak enrichment zones were kept separate and each were further divided into intrusive as one group and remainder as the second group.
- Zones defined as primary by enrichment surfaces were divided to two fundamental groups on a nominal CuT% grade below or above 0.15%. Material above the 0.15% CuT was further divided to skarn and intrusive endoskarns and the remainder.

The approach defined a total of eleven estimation domains for CuT% provided in Table 10. The relevant statistical summary is provided in Table 11.

Table 10: Estimation deomains for CuT%

UE	MINZ	Alterations	Lithology	Envelopes
1	Leached	Potassic Intrusive – Endoskarn Skarn Hornfels	All	
2		Remaining alterations	All	
3	Strong and weak enrichment zones	Intrusive Endoskarn Skarn	All	
4		Remaining alterations	Skarn Mg Skarn	
5	Strong Enrichment	Intrusives (excluding Endoskarn) Hornfels Sediments	Intrusives	
6			Hornfels Sediments – Volcanic	
7	Weak Enrichment		Intrusives	
8			Hornfels Sediments – Volcanic	
9	Primary and Anhydrite	All	All	CuT <0.15%
10		Intrusive Endoskarn Skarn	All	CuT ≥0.15%
11		Remaining alterations	All	

Table 11: Summary statistics by CuT% estimation units

UECUT	No. Composites	Min.	Max.	Mean	Median	Q1	Q3	Variance	Std. Dev.	C.V
1	502	0.001	4.24	0.28	0.19	0.07	0.39	0.11	0.33	1.17
2	2 221	0.001	4.28	0.08	0.02	0.01	0.06	0.04	0.21	2.70
3	3 718	0.01	7.00	0.76	0.65	0.44	0.93	0.28	0.53	0.70
4	559	0.01	8.00	0.69	0.54	0.37	0.84	0.41	0.64	0.94
5	2 361	0.001	4.81	0.54	0.42	0.26	0.68	0.21	0.46	0.85
6	406	0.001	3.67	0.54	0.46	0.29	0.69	0.19	0.43	0.80
7	2 219	0.001	5.46	0.49	0.41	0.25	0.62	0.16	0.40	0.80
8	513	0.001	4.64	0.46	0.34	0.22	0.53	0.21	0.46	1.02
9	7 113	0.001	8.00	0.09	0.07	0.04	0.12	0.02	0.15	1.65
10	10 309	0.01	8.00	0.52	0.42	0.27	0.65	0.18	0.43	0.82
11	11 358	0.001	8.00	0.35	0.27	0.19	0.42	0.11	0.33	0.93

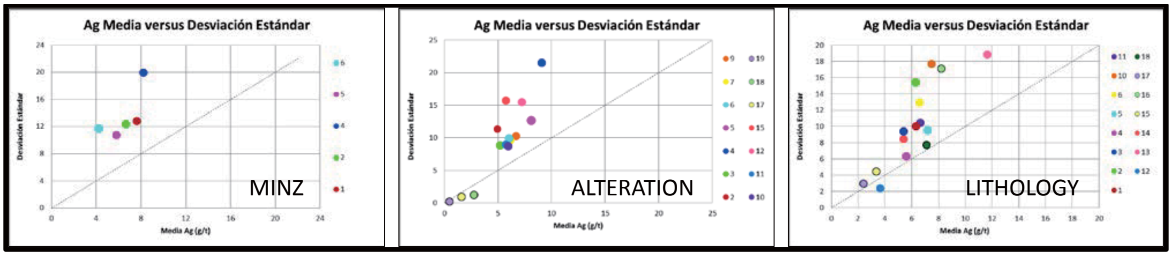
3.7.3.2 Silver (Ag g/t)

An initial examination of the scatter plots of mean versus standard deviation of Ag g/t grouped by each of major categories for Minz, alteration and lithology (see Figure 20) shows a much greater association with lithology than the copper enrichment zones or alterations. This conclusion also holds to some extent when cumulative log probability plots are used (Figure 21). Probability plots show lack of grouping where alterations are concerned but provides some distinction distributions within some of the copper enrichment profiles and very strongly with lithology.

Lithology and Minz were finally used as primary drivers as follows:

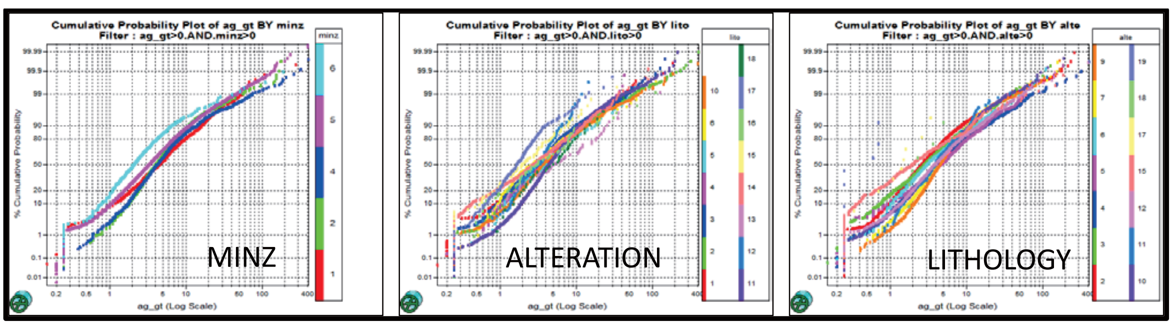
- Primary rock based on Minz appears to be showing a distinct behaviour compared to other enrichment material. As such the Primary material was considered separately.
- Feldspar (3), quartz (4), dacite (5) and Yantac Porphry (6) lithologies show similarities in their cumulative distribution plots but need separation based on primary plus anhydrite and the remainder.
- A similar subdivision by primary plus anhydrite and the remainder is noted for granodiorite (2) and grouped accordingly.
- Diorite (1) has a distinct behaviour for primary rock versus the remainder and grouped accordingly into two separate units.
- Hornfels (10), Basalt (13), skarn (11) and Mg skarns (12) were considered as one group. However, examination of spatial distribution of Ag shows that grade zoning potentially exists lending itself to separation by a nominal grade cut-off of 7 g/t Ag.
- Finally, an estimation domain was defined for Shales (15) and Anhydrite (17) as one group and Calcareous Sediment (14), andesite (16) and sandstones (18) lithologies as another group. These associations have geological and spatial coherence, and contain sufficient samples for interpolation purposes.

The final estimation domain categories are provided in Table 12 with associated statistics in Table 13.



Minz (Left), Alteration (middle) and Lithology (right)

Figure 20: Mean vs standard deviation of Ag g/t composite assays



Grouped by Minz (left), Alterations (Middle) and Lithology (right)

Figure 21: Cumulative log probability plots for Ag g/t

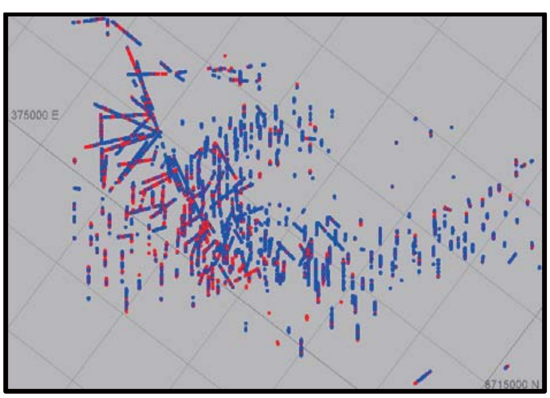


Figure 22: Spatial distribution of Ag g/t for above 7 g/t (red) and below 7 g/t (blue) within hornfels, basalt, skarn and mag skarn lithologies

Table 12: Estimation units for Ag g/t

UEAG	Lithology	Mineral Zone (MINZ)	Alteration	Envelopes
1	Diorite	Primary	All	
2		Remainder		
3	Granodiorite	Primary + Anh	All	
4		Remainder	All	
5	Porphrys: Feldspar, Qz, Dacite, Yantac	Primary + Anh	All	
6		Remainder		
7	Hornfel, Basalt, Skarn	All	All	Ag >7 g/t

UEAG	Lithology	Mineral Zone (MINZ)	Alteration	Envelopes
8	MgSkarn			Ag <7 g/t
9	Anhydrite, Shale	All	All	
10	Sed Calc, Andesite, Sandstone	All	All	

Table 13: Summary statistics by Ag g/t estimation units

UE	No Composites	Min.	Max	Mean	Median	Q1	Q3	Variance	Std. Dev	C.V
1	334	0.20	49	4.15	2.50	1.37	4.70	32	5.6	1.4
2	826	0.15	187	7.17	4.60	2.50	7.90	126	11.2	1.6
3	3 083	0.25	237	5.34	2.70	1.60	4.90	124	11.1	2.1
4	1 450	0.25	405	8.39	3.90	2.40	6.90	478	21.9	2.6
5	2 080	0.20	147	5.50	2.80	1.50	5.41	101	10.1	1.8
6	396	0.70	48	5.87	4.30	2.80	6.41	37	6.1	1.0
7	1 085	0.86	398	15.10	10.30	7.59	14.98	458	21.4	1.4
8	4 652	0.25	216	4.79	3.70	2.45	5.40	54	7.4	1.5
9	363	0.25	30	2.56	1.70	1.05	2.84	9	3.0	1.2
10	670	0.25	111	5.75	2.84	1.21	6.30	91	9.5	1.7

3.7.3.3 Arsenic (As%)

Arsenic is a contaminant element and is considered as one of critical element for the final concentrate.

Cumulative log probability plots for As% by alteration and lithology codes (Figure 23) show very little association between As% assays and that of the lithology or alteration interpretations. Stronger association is noted with mineral zones (MINZ) as presented in Figure 24.

- Arsenic behaviour is comparable in both the leached and high enrichment profiles.
- Both primary (5) and anhydrite (6) show similarities in their As% distribution (see Figure 25 left), therefore were combined into one group. Spatial examination of As% within these units suggest a potential zoning at a nominal cut-off grade of 0.007% As. An envelope was accordingly interpreted to encompass the higher grade As% data.

Table 14 provides the final estimation domains for As%. Associated statistics are presented in Table 15.

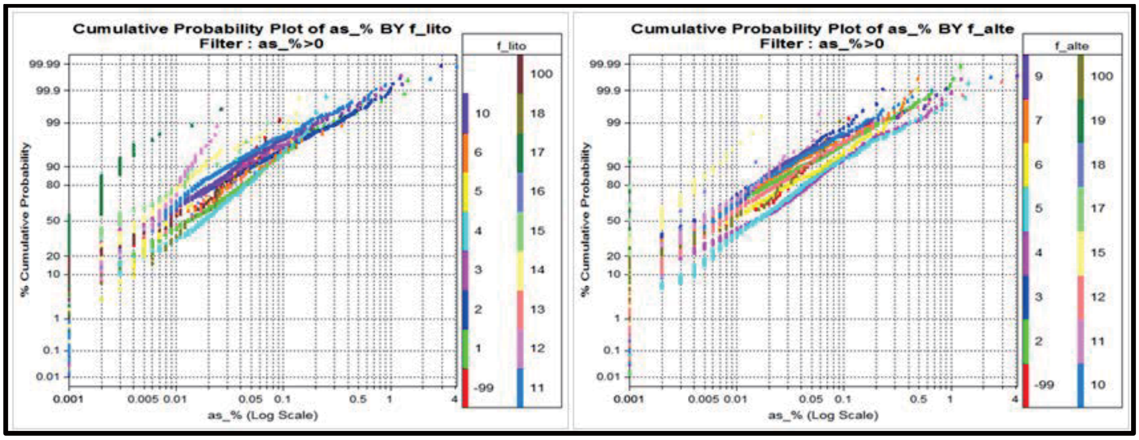


Figure 23: Cumulative log probability plots for As% grouped by lithology (left) and alteration (right)

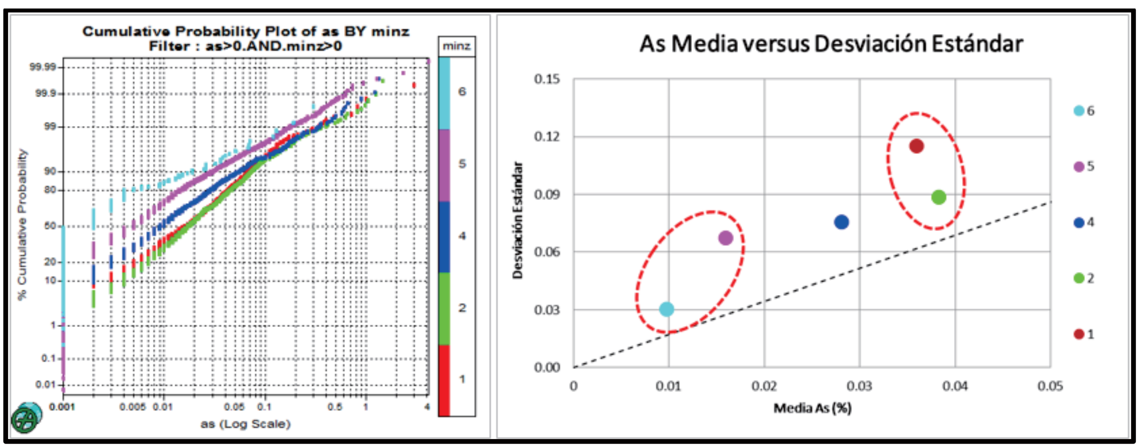


Figure 24: Cumulative log probability plot (left) and scatter plot of mean vs standard deviation (right) for As% by mineral zones (MINZ)

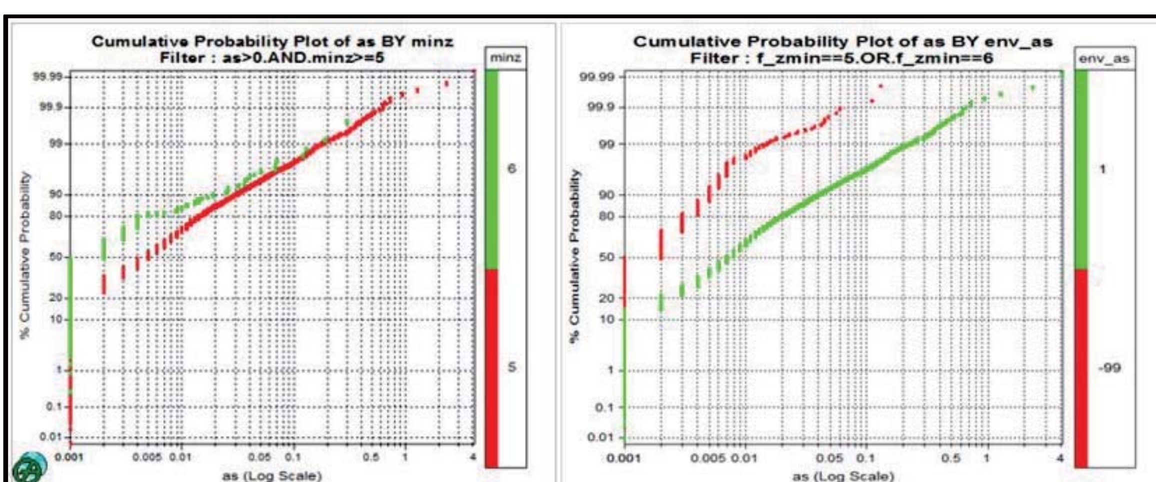


Figure 25: Cumulative log probability plots for As% for primary and anhydrite (left) and that separated by Arsenic envelope interpreted at 0.007% (right)

Table 14: Estimation units for As%

UEAS	Mineral Zones	Lithology	Alteration	Envelopes
1	Leached and High grade enrichment	All	All	
2	Low grade enrichment	All	All	
3	Primary and Anhydrite	All	All	As ≥0.007%
4				As <0.007%
100	Colluvium			

Table 15: Summary statistics by As% estimation units

UEAS	No Composites	Min	Max	Mean	Median	IQ1	IQ3	Variance	Std Devn	C.V
1	2359	0.001	2.950	0.038	0.017	0.008	0.037	0.010	0.102	2.688
2	1638	0.001	1.340	0.028	0.009	0.004	0.023	0.006	0.076	2.708
3	6128	0.001	4.120	0.021	0.007	0.003	0.016	0.006	0.078	3.776
4	2252	0.001	0.130	0.003	0.002	0.001	0.003	0.000	0.005	1.901
100	51	0.001	0.091	0.017	0.009	0.002	0.024	0.000	0.020	1.160

3.7.3.4 Zinc (Zn%)

Zinc is also a contaminant element and is considered as the second critical element for the final concentrate. For assessment and definition of estimation domains associated with Zn% composites, a series of cumulative log probability plots and mean versus standard deviation plots were generated grouped by mineral zones, alteration and lithology (Figure 26). A clear proportional effect is noted with all groups.

Distribution distinctions are not clearly obvious through the cumulative probability plots by mineral zones or alterations, although some association and grouping is noted. Lithology diagrams however show a much stronger possibility of grouping followed by mineral zone and then alterations. The following observations and groupings have been selected:

- Diorite (1) lithology shows a distinct behaviour and is used as a separate group. Examination by mineral zones however suggest that diorite would need to be further separated to high enrichment unit (2) and low enrichment (5) plus primary units.
- Granodiorite lithology (2) also appears distinctive with further sub-division required based on potassic and non-potassic alterations.
- Feldspar (3), quartz (4), dacite (5) and Yantac porphyry (6) lithologies were also considered for grouping into a unit separated by potassic or non-potassic alterations.
- Hornfels (10), Skarn(11), Mg skarn (12), basalt (13) and calcareous sediments (14) formed the next grouping. Mineral zones and alterations do not display any specific trend. However spatial inspection of Zn% for these lithologies demonstrate a potential zoning at 0.2% Zn threshold. Solids were accordingly interpreted and used as low and high grade zinc zones.
- Shale (15), Andesite (16), anhydrite (17) and sandstone (18) formed the final grouping for the zinc estimation units.

Table 16 provides final estimation domains for Zn% with statistics presented in Table 17.

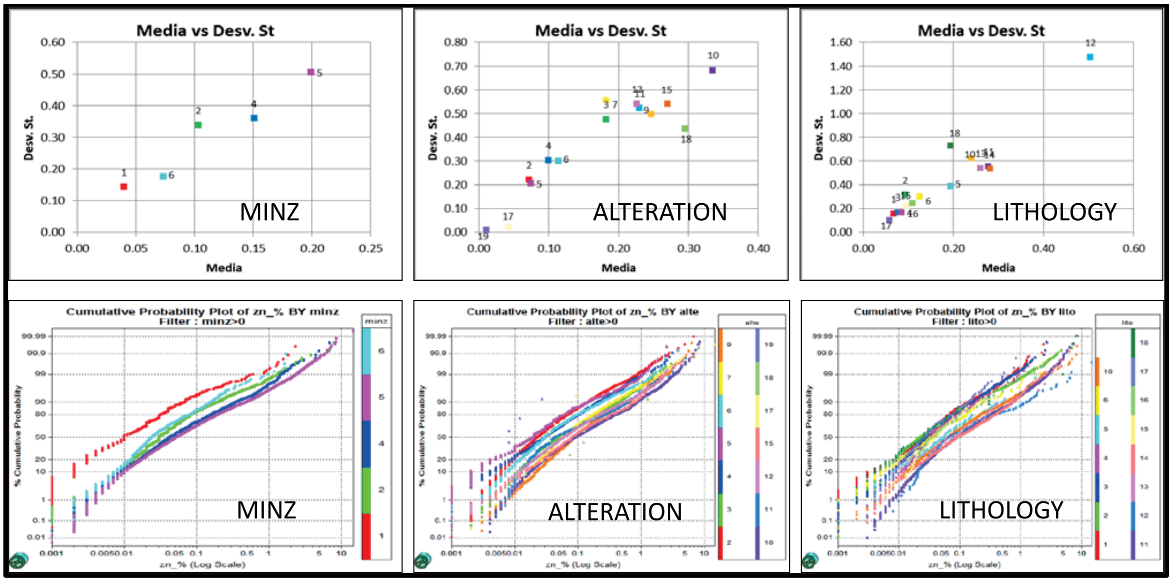


Figure 26: Mean vs Standard Deviation (upper row) and cumulative log probability plots (lower row) for Zn% composite assays grouped by Minz (Left column), Alteration (middle column) and Lithology (right column)

Table 16: Estimation units for Zn%

UEZN	Litology	Mineral Zones	Alteration	Grade Envelopes
1	Diorite	High enrichment	All	
2		Low enrichment and Primary	All	
3	Granodiorite	All	Potassic	
4			Remaining alterations	
5	Porphrys: Feldspar, Qz, Dacitie, Yantac	All	Potassic	
6			Remaining alterations	
7	Hornfels, Skarn, Magnetite Skarn, Basalt, Calcareous sediment	All	All	>0.2%
8				<0.2%
9	Shale, andesite, Anhydrite, sandstone	All	All	
10	All	Leached	All	

Table 17: Summary statistics for Zn% estimation units

	No. Obs	Min.	Max	Mean	Median	IQ1	IQ3	Variance	Std. Dev.	C.V
1	412	0.001	2.36	0.06	0.03	0.01	0.05	0.03	0.16	2.50
2	534	0.004	2.20	0.11	0.05	0.03	0.11	0.04	0.20	1.74
3	2 846	0.001	6.83	0.07	0.02	0.01	0.04	0.06	0.25	3.43
4	1 685	0.001	7.90	0.14	0.04	0.02	0.10	0.18	0.42	2.95
5	921	0.002	1.48	0.06	0.03	0.01	0.05	0.01	0.11	1.94
6	1 621	0.001	2.66	0.11	0.04	0.02	0.09	0.05	0.23	2.18
7	1 676	0.009	14.58	0.77	0.46	0.25	0.91	0.94	0.97	1.26

	No. Obs	Min.	Max	Mean	Median	IQ1	IQ3	Variance	Std. Dev.	C.V
8	5 353	0.003	8.47	0.12	0.06	0.03	0.12	0.09	0.30	2.39
9	460	0.002	4.90	0.09	0.03	0.02	0.07	0.08	0.28	3.09
10	1 193	0.001	2.32	0.04	0.01	0.00	0.03	0.02	0.14	3.64
Total	16 701	0.001	14.58	0.17	0.04	0.02	0.12	0.20	0.45	2.69

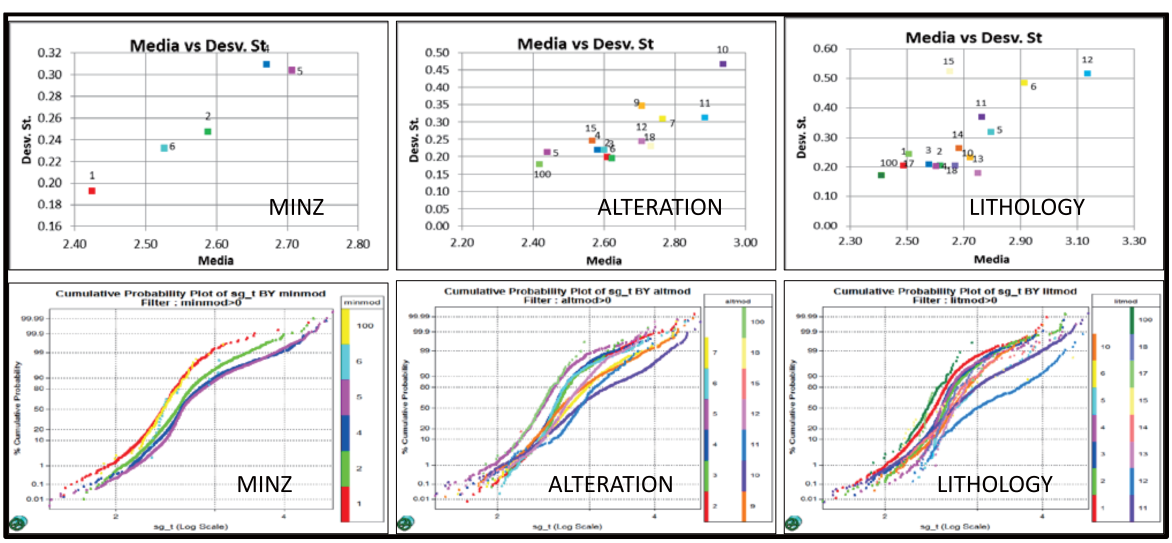
3.7.3.5 Density

The database used for density values corresponding to raw density measurements. The geological codes are those flagged using the geological block model. The final dataset used excludes four potentially anomalous values greater than 6 g/cm^3.

For determination of estimation domains associated with density measurement a series of cumulative log probability plots and mean versus standard deviation plots were generated grouped by mineral zones, alteration and lithology (Figure 27). Three separate groupings are noted using the mineral zone codings. These include Leach material, high enrichment zone and combined low enrichment, primary and anhydrite zones.

Additional control is noted on the last group by examining the lithology and alterations. Magnetic skarn (12) appears as an outlier on the graph requiring to be treated separately. For the remainder of the group alterations argelic (5) and endo skarn (7) stand out as separate domains while the remainder form a similar population.

Final estimation domains for density are provided in Table 18 and associated statistics in Table 19.



Grouped by Minz (Left column), Alteration (middle column) and Lithology (right column)

Figure 27: Mean vs standard deviation (upper row) and cumulative log probability plots (lower row) for density measurements

Table 18: Estimation units for density

UEDENS	Mineral Zones	Lithology	Alteration
1	Gravel	Gravel	Gravel
2	Leached	All	All
3	High enrichment	All	All
4	Low enrichment + primary + anhydrite	All less mag skarn (12)	arg (5)
5		All less mag skarn (12)	All less arg (5) -end sk (7)- mg (18)
6		All less mag skarn (12)	end sk (7)
7		magk (12)	mg (18)

Table 19: Summary statistics by density estimation units

UEDENS	No. Obs	Min.	Max	Mean	Median	IQ1	IQ3	Std. Dev.	C.V
1	2 639	1.61	4.42	2.42	2.42	2.32	2.52	0.19	0.08
2	4 993	1.75	4.51	2.59	2.57	2.45	2.69	0.25	0.1
4	3 504	1.61	4.76	2.67	2.61	2.51	2.77	0.31	0.12
5	15 411	1.52	4.89	2.71	2.63	2.54	2.8	0.3	0.11
6	22	2.32	3.06	2.53	2.43	2.39	2.57	0.23	0.09
100	124	1.88	3.11	2.44	2.43	2.35	2.54	0.18	0.07

3.8 Spatial correlation and variography

Spatial continuity of each estimation domain was analysed using variography. 3D experimental variograms were generated and modelled along drillhole (DTH) and by directional (3D). Variography was carried out using OBO V11.05® software. The variograms were calculated for each Estimation domain separately. Golder conducted the variography through the following process which included:

- Calculation of variogram maps.
- Calculation of downhole and 3D experimental variograms.
- Derivation of the nugget effect downhole DTH variograms.
- Modelling experimental variogram in three principal orientation of major, semi-major and minor directions.

Model variogram parameters for key variables of CuT%, Ag g/t, As%, An% and Density and for each estimation domain are provided in Table 20 to Table 24. Example variogram plots are presented in Figure 28 to Figure 32.

Table 20: Variogram model parameters for CuT% by estimation domains

UECUT	Direction	Nugget	First Structure			Second Structure		
			Sill	Type	Range	Sill	Type	Range
1	0°	0.16	0.41	Sph	17	0.43	Sph	310
	0°				17			310
	0°				17			310
2	0°	0.21	0.34	Sph	83	0.45	Sph	108
	0°				40			108
	0°				53			64
3	120°	0.34	0.43	Sph	54	0.23	Sph	296
	0°				23			280
	0°				35			420
4	30°	0.32	0.35	Sph	124	0.33	Sph	231
	0°				13			123
	0°				10			404
5	55°	0.28	0.44	Sph	84	0.28		300
	0°				25			155
	0°				40			140
6	0°	0.10	0.52	Sph	17	0.38	Sph	205
	0°				17			205
	0°				17			205
7	115°	0.36	0.24	Sph	67	0.40	Sph	446
	0°				21			225
	0°				42			170
8	0°	0.22	0.01	Sph	87	0.77	Sph	281
	0°				87			281
	0°				87			281
9	60°	0.32	0.27	Sph	71	0.41	Sph	233
	0°				15			237
	0°				10			264
10	0°	0.36	0.22	Sph	39	0.42	Sph	420
	0°				100			320
	0°				28			200
11	100°	0.38	0.38	Sph	124	0.24	Sph	515
	0°				115			336
	0°				95			308

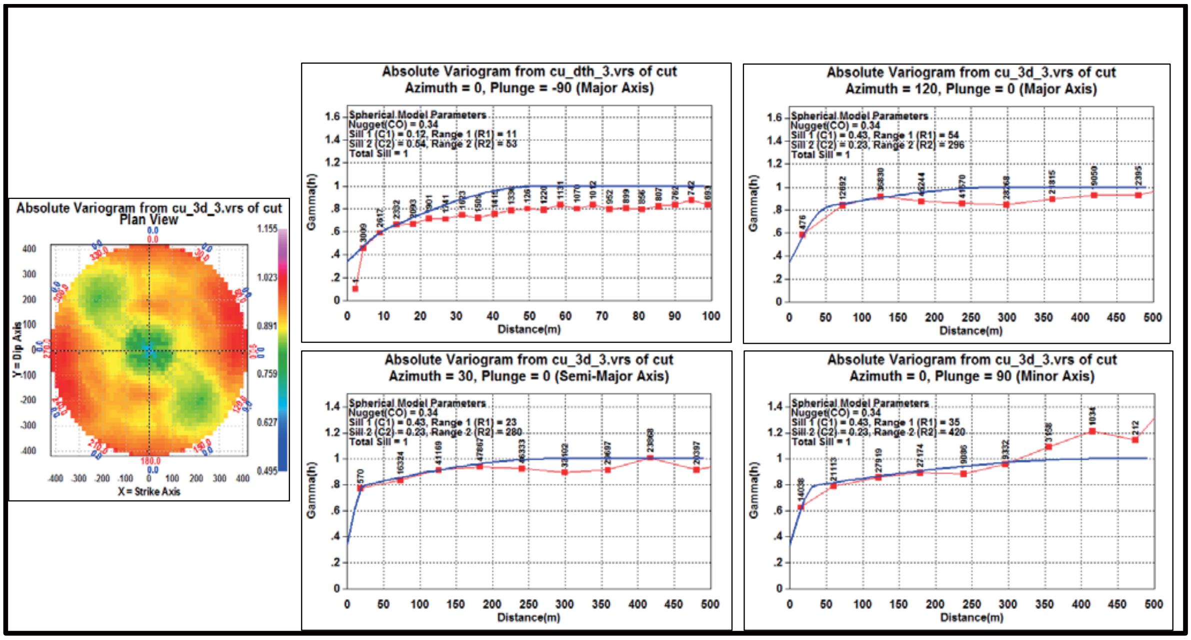


Figure 28: Experimental and modelled variograms for estimation domain 3 – CUT%

Table 21: Variogram model parameters for Ag g/t by estimation domains

UEAG	Direction	Nugget	First Structure			Second Structure			Direction		
			Sill	Type	Range	Sill	Type	Range	Sill	Type	Range
	0°				200						
1	0°	0.5	0.7	Sph	200						
	0°				200						
	0°				31			230			
2	0°	0.2	0.43	Sph	31	0.2	Sph	230			
	0°				31			230			
	15°				40			180			220
3	0°	0.35	0.18	Sph	40	0.23	Sph	220	0.24	Sph	260
	0°				35			35			350
	155°				160			250			
4	0°	0.35	0.4	Sph	75	0.25	Sph	350			
	0°				22			250			
	0°				200			360			
5	0°	0.4	0.4	Sph	100	0.2	Sph	200			
	0°				75			9999			
	0°				52			120			
6	0°	0.3	0.45	Sph	52	0.37	Sph	120			
	0°				52			120			
	45°				40			350			9999
7-8	0°	0.4	0.32	Sph	200	0.13	Sph	350	0.15	Sph	9999
	0°				50			500			500

UEAG	Direction	Nugget	First Structure			Second Structure			Direction		
			Sill	Type	Range	Sill	Type	Range	Sill	Type	Range
	0°				25			200			
9	0°	0.2	0.33	Sph	25	0.27	Sph	200			
	0°				25			200			
	0°				28			250			
10	0°	0.4	0.2	Sph	28	0.56	Sph	250			
	0°				28			250			

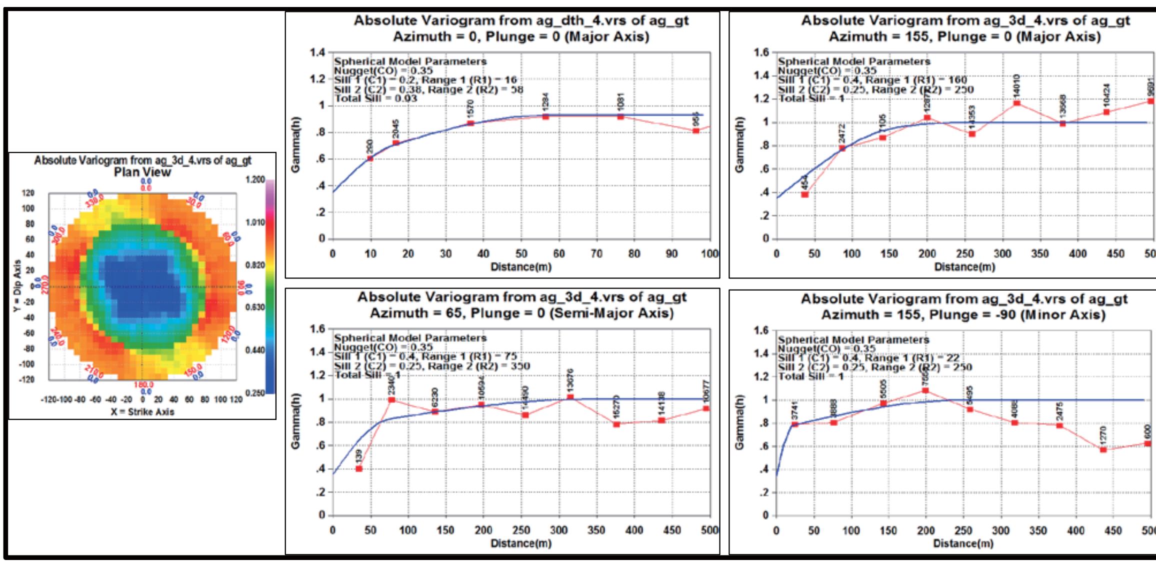


Figure 29: Experimental and modelled variograms for estimation domain 4 – Ag g/t

Table 22: Variogram model parameters for As% by estimation domains

UEAG	Direction	Nugget	First Structure			Second Structure			Direction		
			Sill	Type	Range	Sill	Type	Range	Sill	Type	Range
	0°				80			480			
1	0°	0.2	0.34	Sph	80	0.46	Sph	480			
	0°				80			480			
	0°				310			520			
2	0°	0.4	0.16	Sph	310	0.44	Sph	520			
	0°				310			520			
	15°				150			200			500
3	0°	0.05	0.04	Sph	120	0.11	Sph	330	0.15	Sph	99 999
	0°				60			574			99 999
	155°				90			600			
4	0°	0.2	0.36	Sph	90	0.09	Sph	600			
	0°				90			600			

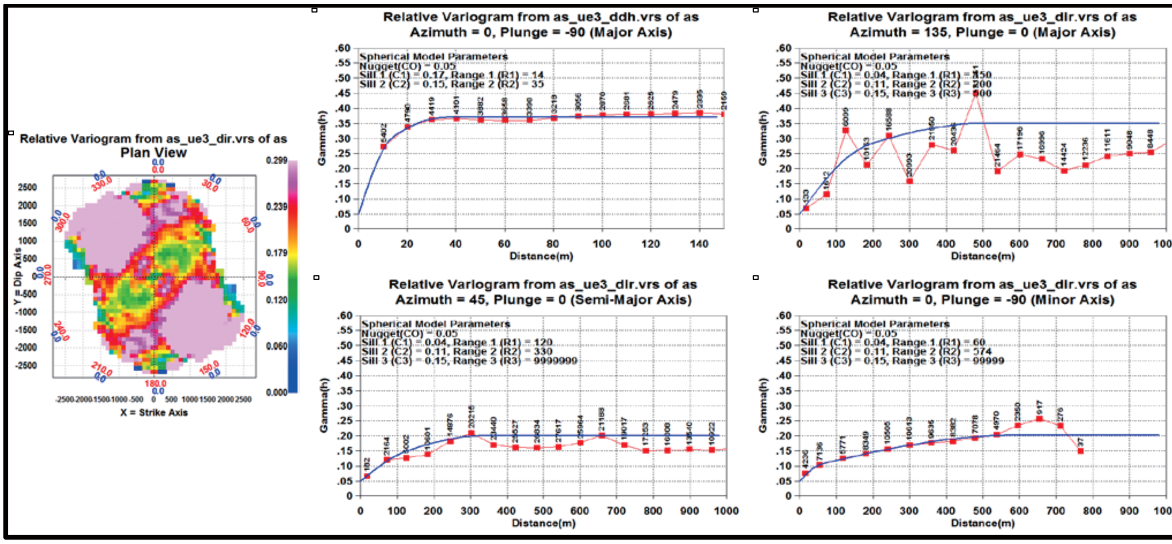


Figure 30: Experimental and modelled variograms for estimation domain 3 – As%

Table 23: Variogram model parameters for Zn% by estimation domains

UEZN	Direction	Nugget	First Structure			Second Structure			Direction		
			Sill	Type	Range	Sill	Type	Range	Sill	Type	Range
3	120	0.65	0.19	SPH	100	0.16	SPH	300			
	0				180			180			
	0				50			270			
4	130	0.40	0.30	SPH	110	0.10	SPH	160	0.20	SPH	260
	0				250			400			500
	0				25			111			9 999
6	120	0.20	0.56	SPH	300	0.04	SPH	400	0.40	SPH	500
	0				250			280			9 999
	0				23			100			9 999
7	50	0.30	0.51	SPH	130	0.19	SPH	150	0.20	SPH	9 999
	0				40			200			9 999
	0				20			140			180
8	155	0.30	0.58	SPH	58	0.12	SPH	300	0.10	SPH	9 999
	0				50			100			150
	0				21			100			9 999
10	0	0.20	0.13	SPH	250	0.16	SPH	300	0.51	SPH	9 999
	0				235			9999			99 999
	0				180			190			200
1	0°/0°/0°	0.4	0.10	SPH	37	0.50	SPH	245			
2	0°/0°/0°	0.4	0.10	SPH	37	0.50	SPH	245			
5	0°/0°/0°	0.3	0.35	SPH	23	0.10	SPH	150			
9	0°/0°/0°	0.4	0.10	SPH	33	0.50	SPH	250			

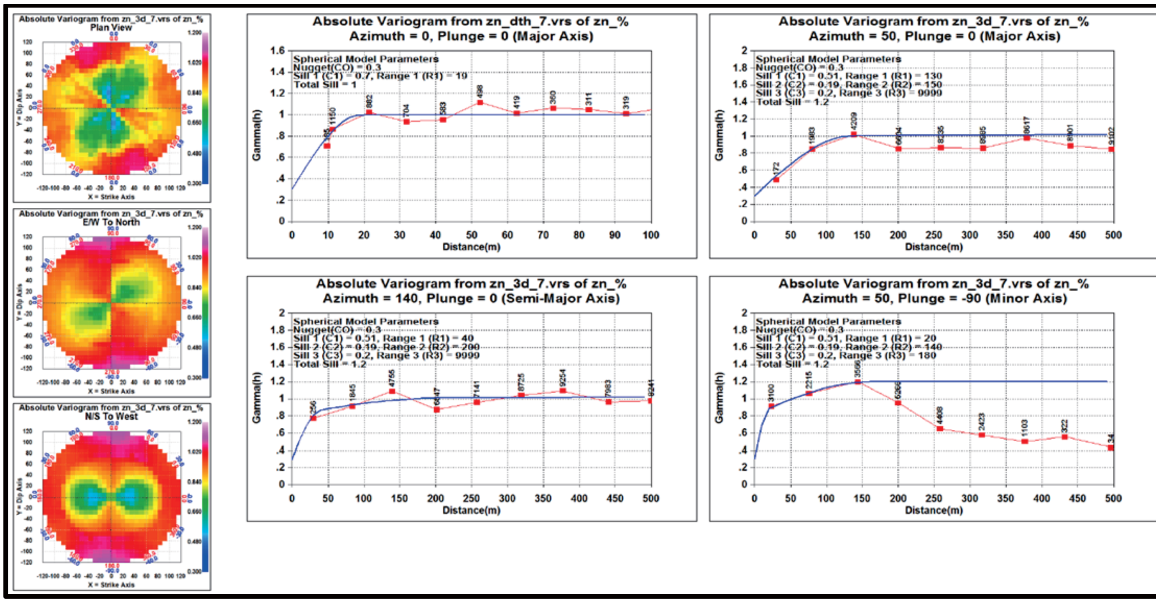


Figure 31: Experimental and modelled variograms for estimation domain 7 – Zn%

Table 24: Variogram model parameters for density by estimation domains

UEDEN	Direction	Nugget	First Structure			Second Structure		
			Sill	Type	Range	Sill	Type	Range
	45				36			246
2	0	0.38	0.26	SPH	36	0.36	SPH	166
	0				20			124
	130				140			400
3	0	0.52	0.37	SPH	112	0.11	SPH	300
	0				30			200
	0				34			250
4*	0	0.43	0.26	SPH	34	0.31	SPH	250
	0				34			250
	105				53			286
5	0	0.44	0.19	SPH	20	0.37	SPH	142
	0				20			231
	90				118			185
6	0	0.41	0.47	SPH	160	0.12	SPH	250
	0				21			160
	0				170			478
7*	0	0.15	0.58	SPH	170	0.27	SPH	478
	0				170			478

Note: * Due to data sparsity and quantity of the available data an omnidirectional variogram was used for estimation units 4 and 7

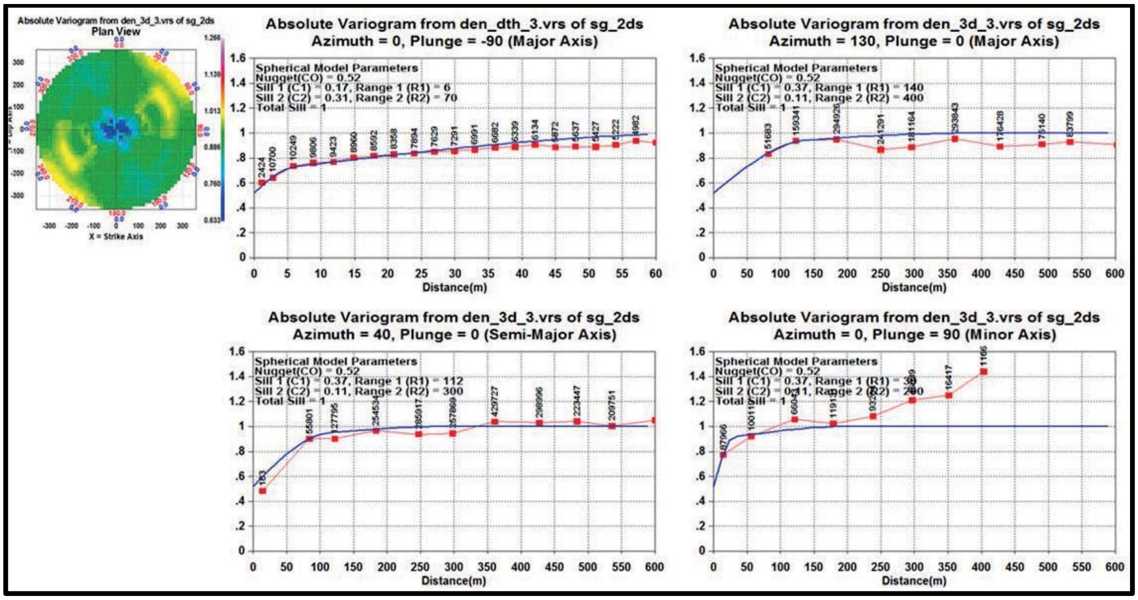


Figure 32: Experimental and modelled variograms for estimation domain 3 – density

3.8.1 Contact analysis

Contact analysis were carried out on the composite samples to establish the approach for treatment of each domain contacts during the interpolation process. For assessment of the style of contacts, the contact analysis plots were used. Plots (Figure 33 to Figure 37) show the average grade (solid blue and average dotted blue to the right and solid green and average dotted green to the left) and number of samples (shaded grey area). Left on the X-Axis is above the contact, and right on the X-Axis is below the contact. Three styles of contacts were determined concerning each estimation domain.

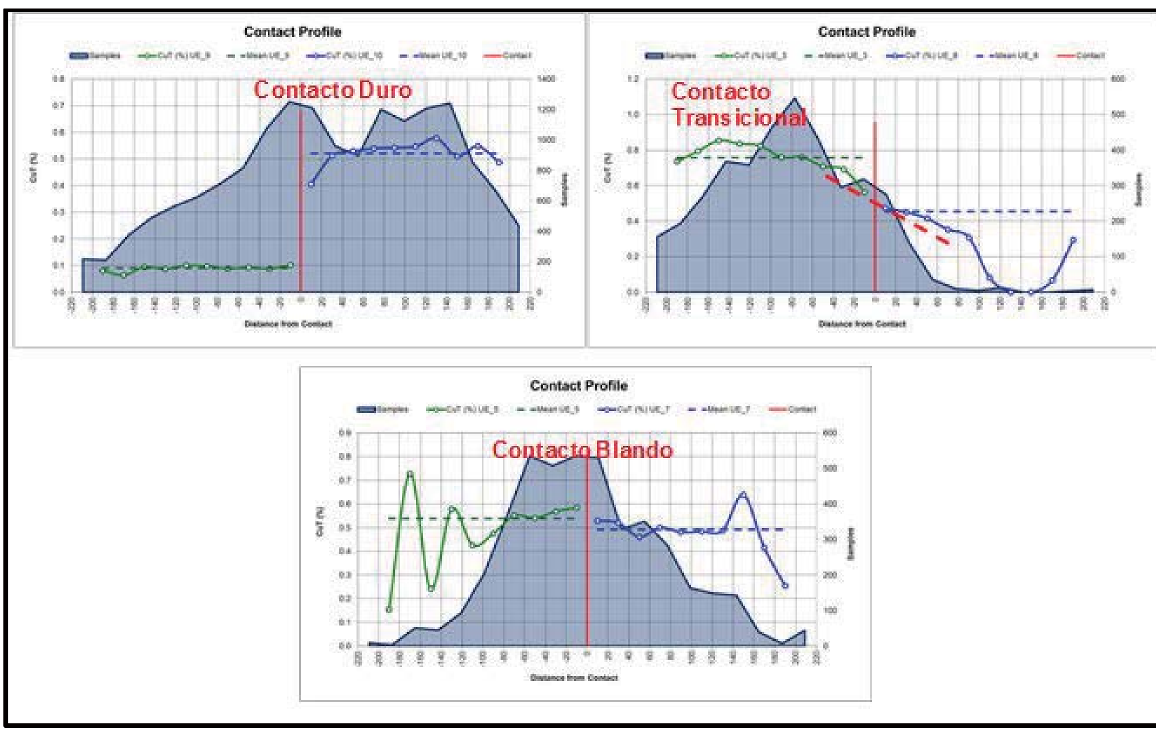
- Hard boundary contacts, where the blocks are estimated using the composites from the estimation domain being estimated
- Transitional boundary contacts, where the block estimates are allowed to be influenced by neighbouring estimation domain samples within short distances (e.g. for pass 1 or 2 estimates)
- Soft boundary contacts where estimated blocks are allowed to be influenced by samples from neighbouring estimation domains for all distances.

Results of the analysis are presented in Table 25 to Table 29 with contact plot examples provided in Figure 33 to Figure 37 for Cut%, Ag g/t, As%, Zn% and Density.

Table 25: Contact type for CUT%

UE	1	2	3	4	5	6	7	8	9	10	11
1		D	D	D	D	D	D	T	D	T	D
2			D	D	D	D	T	T	D	T	T
3				T	D	D	D	T	D	T	D
4					B	D	D	D	D	D	T
5						D	B	D	T	D	D
6							D	D	D	D	B
7								D	T	D	B
8									D	B	T
9										D	D
10											D
11											

Contact Types: D = hard; T = transitional; B = soft



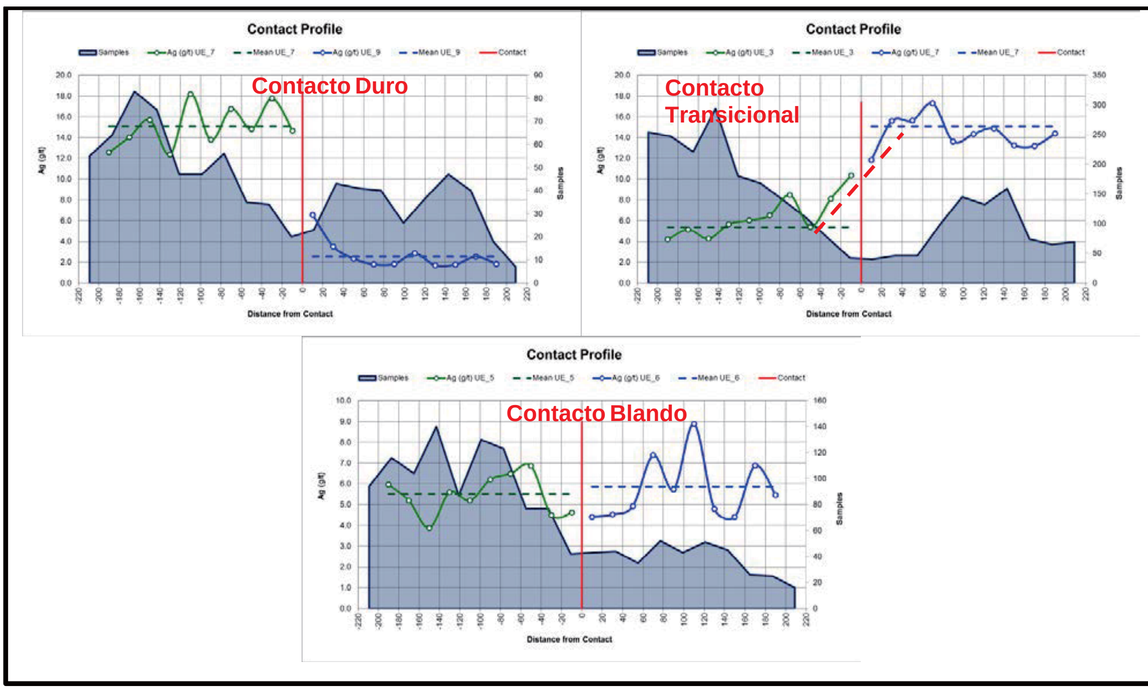
Showing hard contact between domains 9 and 10 (upper left), transitional contact between domains 3 and 8 (upper right) and soft contact between domains 5 and 7 (lower).

Figure 33: Example of contact analysis plot for CUT

Table 26: Contact type for Ag g/t

UEAG	1	2	3	4	5	6	7	8	9	10
1		T	D	D	D	D	D	D	D	D
2			D	T	T	D	D	T	D	T
3				D	T	D	T	D	D	D
4					D	D	D	T	D	T
5						B	D	T	D	D
6							T	T	D	D
7								T	D	D
8									D	D
9										B
10										

Contact Types: D = hard; T = transitional; B = soft



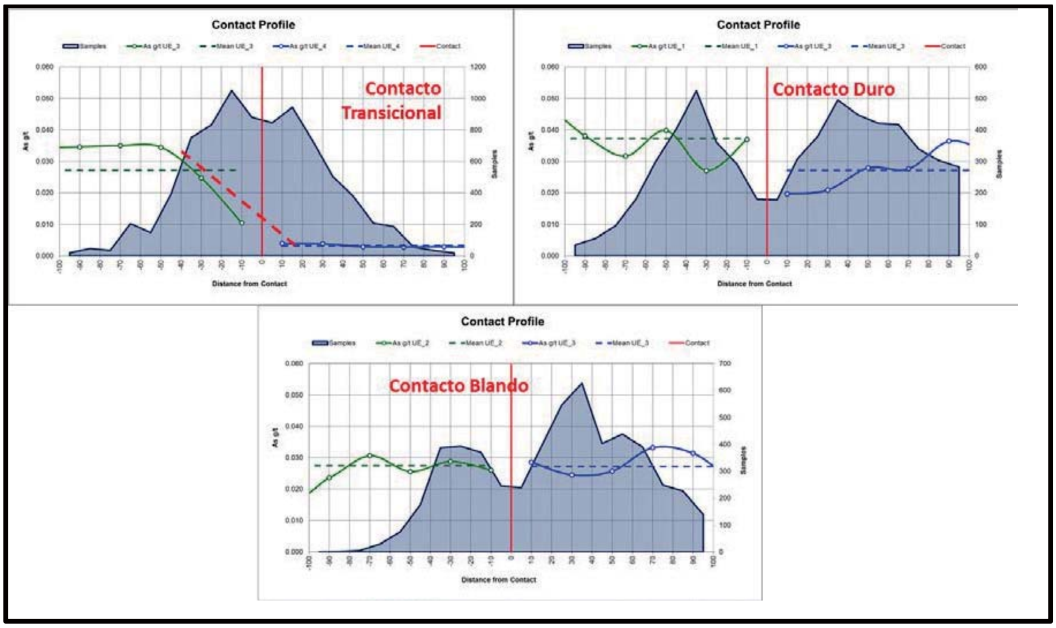
Showing hard contact between domains 7 and 9 (upper left), transitional contact between domains 3 and 7 (upper right) and soft contact between domains 5 and 6 (lower).

Figure 34: Example of contact analysis plot for Ag g/t

Table 27: Contact type for As%

UE	1	2	3	4
1		D	D	D
2			B	D
3				T
4				

Contact Types: D = hard; T = transitional; B = soft



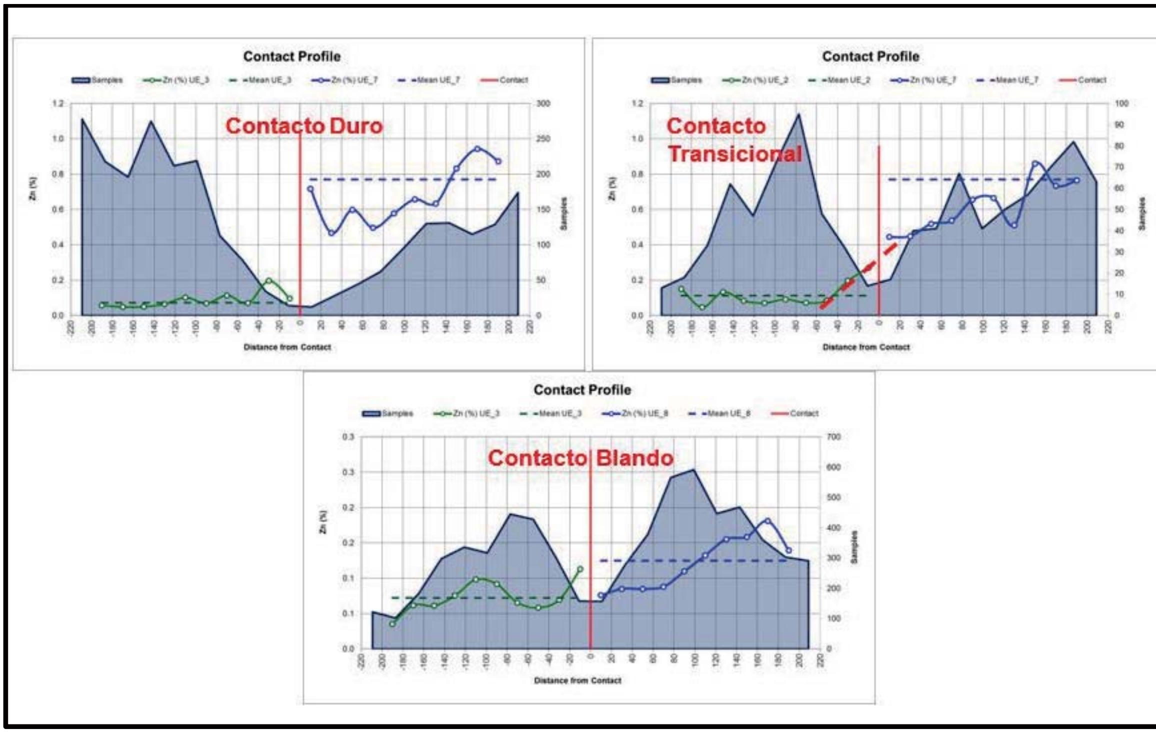
Showing hard contact between domains 3 and 4 (upper left), transitional contact between domains 1 and 3 (upper right) and soft contact between domains 2 and 3 (lower).

Figure 35: Example of contact analysis plot for As%

Table 28: Contact type for Zn%

UE	1	2	3	4	5	6	7	8	9	10
1		D	D	D	D	D	D	D	D	D
2			D	D	D	D	T	D	D	D
3				D	D	D	D	B	D	D
4					D	D	T	D	D	T
5						D	B	D	D	D
6							T	D	D	D
7								T	B	D
8									D	T
9										D
10										

Contact Types: D = hard; T = transitional; B = soft



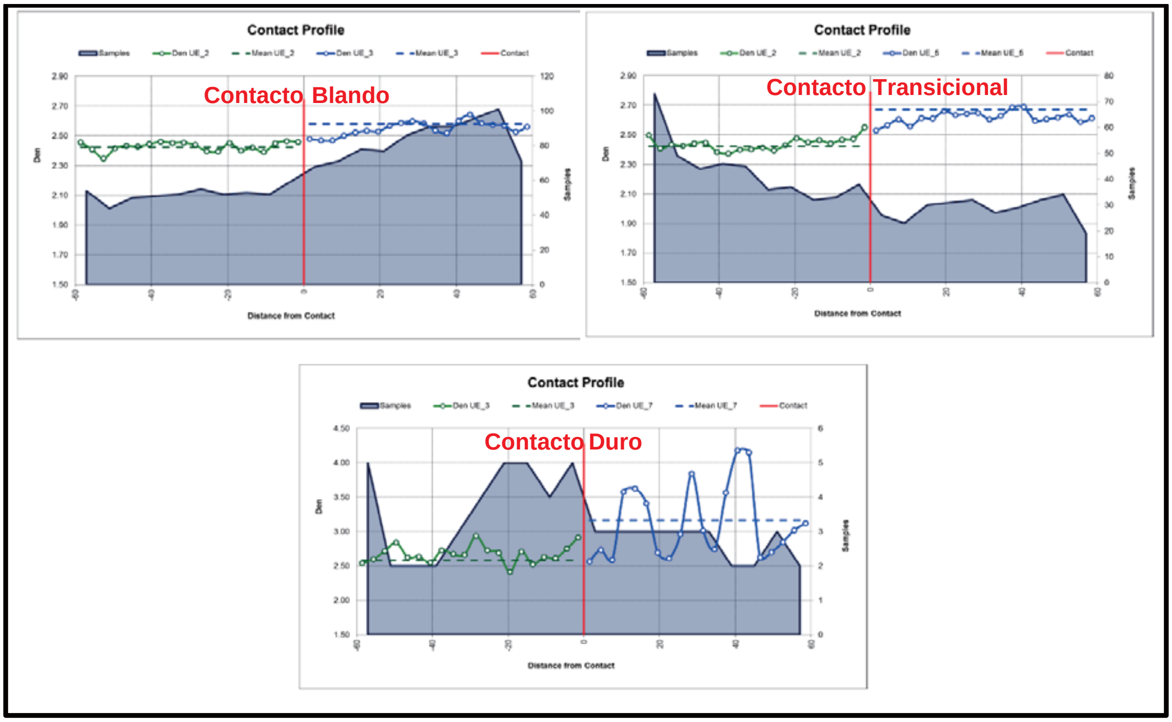
Showing hard contact between domains 3 and 7 (upper left), transitional contact between domains 2 and 7 (upper right) and soft contact between domains 3 and 8 (lower).

Figure 36: Example of contact analysis plot for Zn%

Table 29: Contact type for density

UE	1	2	3	4	5	6	7
1		T	T	D	D	D	D
2			B	T	T	D	D
3				T	B	T	D
4					T	D	D
5						B	T
6							D
7							

Contact Types: D = hard; T = transitional; B = soft



Showing hard contact between domains 2 and 3 (upper left), transitional contact between domains 2 and 5 (upper right) and soft contact between domains 3 and 7 (lower).

Figure 37: Example of contact analysis plot for density

3.9 Grade estimation

Grade interpolation by Ordinary Kriging was implemented using a combination of hard, transition and soft boundary (Section 3.8.1) conditions for each of the estimation domains. The process of estimation involved three passes.

Kriging was based on the 4.5 m composites for CuT% and 10.5 m composites for all other elements with the exception of Density that used the original raw sample measurements.

Kriging was performed for CuT%, Soluble Copper (CuAS and CuASCN), Mo%, Ag g/t, Au g/t, Pb%, As%, Zn% and Density.

The search distance was progressively increased for each pass to enable estimation of more blocks in the block model. Other considerations were the minimum and maximum number of samples used per octant and the maximum number of samples per drill hole. Table 30 provides the overall search distances for each kriging pass. These distances have been applied every domain and every variable being interpolated. Other search parameters used are tabulated in Table 31.

Table 30: Overall search distances used for all elements by pass

UE	Axis	Pass 1	Pass 2	Pass 3	Pass 4
All	Major	60	120	240	360
	Semi	60	120	240	360
	Minor	30	60	120	180

Table 31: Search parameters used for estimation for Cut/Ag/Zn/As

UG	Pass	Min Comps	Max Comps	Max Samps Per Oct	Outlier Treatment	HYR Radius	Max Samp Per DH
1	1	5/4/4/4	12/12/12/12	2/-/-/2	-/Cap/Yes/Yes	40 × 40 × 20/-/30 × 30 × 22.5/10 × 10 × 7.5	-/3/3/2
	2	6/4/4/4	14/12/12/12	2/-/-/2	-/Cap/Yes/Yes	40 × 40 × 20/-/30 × 30 × 22.5/10 × 10 × 7.5	-/3/3/2
	3	6/4/4/4	16/16/16/16	3/-/-/-	Cap/Cap/cap/-	40 × 40 × 20/-/-/-	3/2/2/1
	4	4/4/4/4	24/16/16/16	3/-/-/-	Cap/Cap/cap/-	40 × 40 × 20/-/-/-	-/2/2/1
2	1	5/4/4/4	12/12/12/12	2/-/-/-	-/-/Yes/Yes	40 × 40 × 20/-/30 × 30 × 22.5/10 × 10 × 7.5	-/3/3/3
	2	6/4/4/4	14/12/12/12	2/-/-/-	-/-/Yes/Yes	40 × 40 ×/-/30 × 30 × 22.5/10 × 10 × 7.5	-/3/3/3
	3	6/4/4/4	16/16/16/16	3/-/-/-	Cap/Cap/cap/-	-/-/-/-	3/2/2/2
	4	4/4/4/4	24/16/16/16	3/-/-/-	Cap/Cap/cap/-	-/-/-/-	-/2/2/2
3	1	5/4/4/4	12/12/12/12	2/-/-/2	-/-/-/Yes	60 × 60 × 30/-/-/10 × 10 × 7.5	3/3/3/2
	2	6/4/4/4	14/12/12/12	2/-/-/2	-/-/-/Yes	60 × 60 × 30/-/-/10 × 10 × 7.5	3/3/3/2
	3	6/4/4/2	16/16/16/16	3/-/-/-	Cap/Cap/cap/-	60 × 60 × 30/-/-/-	3/2/2/1
	4	4/4/4/2	24/16/16/16	3/-/-/-	Cap/Cap/cap/-	60 × 60 × 30/-/-/-	-/2/2/1
4	1	5/4/4/4	12/12/12/12	2/-/-/-	-/-/-/Yes	60 × 60 × 30/-/-/10 × 10 × 7.5	3/3/3/3
	2	6/4/4/4	14/12/12/12	2/-/-/-	-/-/-/Yes	60 × 60 × 30/-/-/10 × 10 × 7.5	3/3/3/3
	3	6/4/4/4	16/16/16/16	3/-/-/-	Cap/Cap/cap/-	-/-/-/-	3/2/2/2
	4	4/4/4/4	24/16/16/16	3/-/-/-	Cap/Cap/cap/-	-/-/-/-	-/2/2/2
5	1	5/4/4/	12/12/12/	2/-/-/	-/Cap/Yes/	60 × 60 × 30/-/30 × 30 × 22.5/	3/3/3/
	2	6/4/4/	14/12/12/	2/-/-/	-/Cap/Yes/	60 × 60 × 30/-/30 × 30 × 22.5/	3/3/3/
	3	6/4/4/	16/16/16/	3/-/-/	Cap/Cap/cap/	-/-/-/	3/2/2/
	4	4/4/4/	24/16/16/	3/-/-/	Cap/Cap/cap/	-/-/-/	-/2/2/
6	1	5/4/4/	12/12/12/	2/-/-/	-/Cap/Yes/	60 × 60 × 30/-/30 × 30 x22.5/	3/3/3/
	2	6/4/4/	14/12/12/	2/-/-/	-/Cap/Yes/	60 × 60 × 30/-/30 × 30 × 22.5/	3/3/3/
	3	6/4/4/	16/16/16/	3/-/-/	Cap/Cap/cap/	-/-/-/	3/2/2/
	4	4/4/4/	24/16/16/	3/-/-/	Cap/Cap/cap/	-/-/-/	-/2/2/
7	1	5/4/4/	12/12/12/	2/-/-/	-/Cap/cap/	60 × 60 × 30/-/-/	3/3/3/
	2	6/4/4/	14/12/12/	2/-/-/	-/Cap/cap/	60 × 60 × 30/-/-/	3/3/3/
	3	6/4/4/	16/16/16/	3/-/-/	Cap/Cap/cap/	-/-/-/	3/2/2/
	4	4/4/4/	24/16/16/	3/-/-/	Cap/Cap/cap/	-/-/-/	-/2/2/
8	1	5/4/4/	12/12/12/	2/-/-/	-/Cap/cap/	60 × 60 × 30/-/-/	3/3/3/
	2	6/4/4/	14/12/12/	2/-/-/	-/Cap/cap/	60 × 60 × 30/-/-/	3/3/3/
	3	6/4/4/	16/16/16/	3/-/-/	Cap/Cap/cap/	60 × 60 × 30/-/-/	3/2/2/
	4	4/4/4/	24/16/16/	3/-/-/	Cap/Cap/cap/	60 × 60 × 30/-/-/	-/2/2/
9	1	5/4/4/	12/12/12/	2/-/-/	-/Cap/Yes/	40 × 40 × 20/-/10 × 10 × 7.5/	3/3/3/
	2	6/4/4/	14/12/12/	2/-/-/	-/Cap/Yes/	40 × 40 × 20/-/10 × 10 × 7.5/	3/3/3/
	3	6/4/4/	16/16/16/	3/-/-/	Cap/Cap/cap/	-/-/-/	3/2/2/
	4	4/4/4/	24/16/16/	3/-/-/	Cap/Cap/cap/	-/-/-/	-/2/2/

UG	Pass	Min Comps	Max Comps	Max Samps Per Oct	Outlier Treatment	HYR Radius	Max Samp Per DH
10	1	5/4/4/	12/12/12/	2/-/-/	-/Cap/Yes/	60 × 60 × 30/-/10 × 10 × 7.5/	3/3/3/
	2	6/4/4/	14/12/12/	2/-/-/	-/Cap/Yes/	60 × 60 × 30/-/10 × 10 × 7.5/	3/3/3/
	3	6/4/4/	16/16/16/	3/-/-/	Cap/Cap/cap/	-/-/-/	3/2/2/
	4	4/4/4/	24/16/16/	3/-/-/	Cap/Cap/cap/	-/-/-/	-/2/2/
11	1	5	12	2	-	40 × 40 × 20	3
	2	6	14	2	-	40 × 40 × 20	3
	3	6	16	3	Cap	-	3
	4	4	24	3	Cap	-	-

3.9.1 High-grade cutting

Definition and control of high grade outlier samples is a critical and necessary step in most interpolations, helping to avoid over-estimation of grades.

A combination of two approaches were used at Toromocho:

- Capping – In this approach anomalous values were defined as the upper 1% of the cumulative probability distribution plots. Capping considers outliers globally.
- Restraining – In this approach the influence of high grades are spatially restrained. Outliers values for re-straining purposes were defined by a cross-validation approach in that each sample position is estimated using average of neighbouring samples but excluding the sample being estimated (true value). If the true value is higher than the two standard deviation of samples within the neighbourhood, then that sample is flagged as an outlier. Samples defined as a restraining outlier are controlled using High Yield (HYR) approach that restricts the influence of such samples to within 2 to 3 blocks in the neighbourhood.

Table 32 provides summary of the high grade capping thresholds used for estimation purposes.

Although high-grade cutting is considered by Golder as essential. Application of cutting or re-straining on penalty elements such as As% and Zn% may equally cause undesirable levels of under-estimations.

Golder recommends further sensitivity analysis to fine tune the level of high grade control on penalty elements.

Table 32: High grade capping thresholds used for various domains and variables

UE	CuT%	Ag G/t	As%	Zn%
1	1.11	32.12	0.36	0.57
2	0.85	46.55	0.33	0.94
3	2.93	52.88	0.29	1
4	2.65	72.73	0.02	1.85
5	2.45	51.44		0.61
6	2.03	37.36		1.22
7	1.91	102.63		4.61
8	2.33	23.95		1.29
9	0.4	14.42		0.89

UE	CuT%	Ag G/t	As%	Zn%
10	2.07	41.62		0.55
11	1.45			

3.10 Block model validation

This section contains details of a series of validation checks undertaken by Golder on the Mineral Resource block model against the 4.5 m and 10.5m composite data.

3.10.1 Global statistics

Global statistics of the block model (split by Domain) were compared to cell-declustered 4.5 m composites for CuT% estimates and 10.5 m composite statistics for other elements, to check for reproduction of global mean grades. Table 33 shows an example of such statistical comparison for CuT%.

The initial comparisons indicated that the block model grades are largely lower than the composite averages. This is an expected behaviour due to the application of high grade cutting and restraining.

As a general rule, block average grade estimates should be within ±10% when compared to the corresponding composite grades. With the exception of domain 9, which is a very low grade domain, all other domains appear to perform well against the composite averages.

3.10.2 Swath plots

Swath plots are used to assess the block model estimates for global bias. The estimates should have a close relationship to the drill hole composite data used for estimation. The plots are useful for assessing average grade conformance, and also to detect for potential interpolation issues. The relationship between model and sample panel averages was assessed in the form of scatter plots and Q-Q plots. This allows some assessment of the smoothing effect of the performed interpolation.

Swath plots were produced for each domain and each element for block model overlaid with composite data. An example is shown in Figure 38.

All the swath plot validations show good conformance for material below 0 m RL. A marked difference is noted for blocks above 0 m RL where average block grades are lower than composite data. Although the differences are lower for the Cut Au_0.9 composites the conservatism of the model Au grade for material above 0 m RL remains.

The swath plot validations are acceptable in confirming the reproduction of local grade variations below 0 m RL. Above this level the block model appears to be lower than the data supplied.

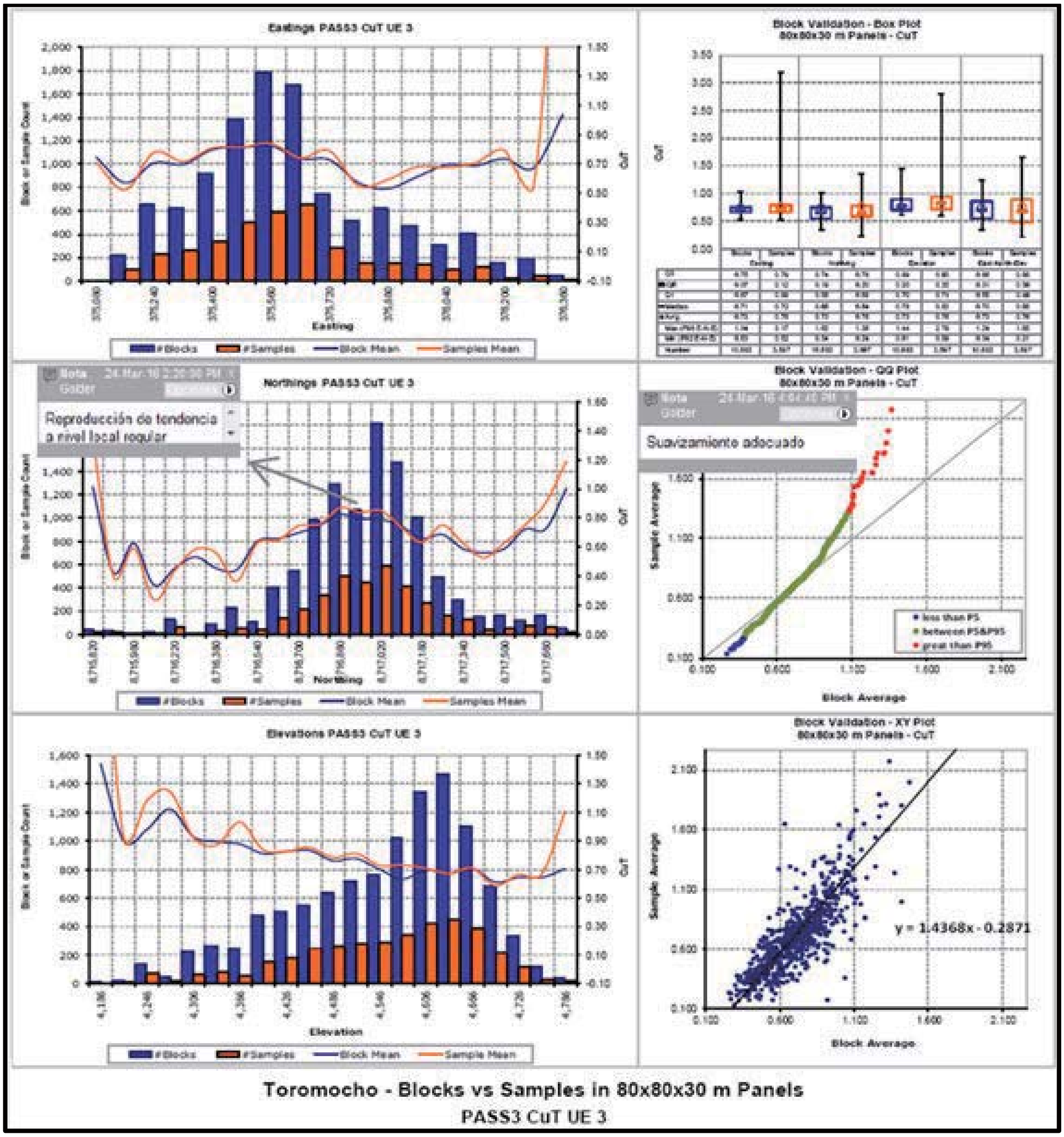


Figure 38: Estimation domain 3 – swath plots for CuT

Table 33: Global statistical comparison between block grades and 4.5 m composite grades (declustered) split by domain for CuT%

UE	No. Observations		Minimum		Maximum		Mean		Relative Difference% (OK-DH)/DH
	Comps	Blocks	Comps	OK	Comps	OK	Comps	OK	
1	502	4788	0.00	0.00	4.24	1.06	0.28	0.26	-6.8%
2	2221	15040	0.00	0.00	4.28	1.30	0.07	0.06	-16.9%
3	3718	18230	0.01	0.15	7.00	2.51	0.75	0.72	-3.6%
4	559	7604	0.01	0.10	8.00	3.24	0.69	0.66	-5.3%

UE	No. Observations		Minimum		Maximum		Mean		Relative Difference% (OK-DH)/DH
	Comps	Blocks	Comps	OK	Comps	OK	Comps	OK	
5	2361	13774	0.00	0.01	4.81	2.63	0.48	0.46	-3.2%
6	406	2832	0.00	0.01	3.67	1.70	0.41	0.38	-6.0%
7	2219	16377	0.00	0.01	5.46	1.91	0.48	0.46	-3.7%
8	513	2457	0.00	0.03	4.64	2.39	0.53	0.40	-25.2%
9	7113	148793	0.00	0.00	8.00	2.37	0.10	0.08	-12.0%
10	10309	93817	0.01	0.09	8.00	3.23	0.52	0.50	-3.4%
11	11358	169081	0.00	0.03	8.00	3.02	0.33	0.31	-7.3%

3.11 Metallurgical factors and assumptions

The JORC Code (2012 edition) clearly states that all reports of Mineral Resources must satisfy the requirement that there are reasonable prospects for eventual economic extraction. The term 'reasonable prospect for eventual economic extraction' implies an assessment (albeit preliminary), by the Competent Person, in respect to all matters likely to influence the prospect of economic extraction. Included in this is the basis for assumptions or predictions regarding the metallurgical amenability.

The process recovery estimate has assumed a metallurgical copper recovery of 80 to 85% (average 82%). The actuals to date suggest an average copper recovery of approximately 70%. Latest recovery factors reported by the processing plant for 2016 suggests and improved recovery to 72%.

The improvement required from the current ±70% metallurgical recovery to the planned average 82% recovery is dependent upon a series of steps in the improving the grinding circuit, optimising reagents, and using CMS in the cleaners for talc depression.

Although assumed average recovery of 82% is considered to be optimistic, Golder believes that the condition of reasonable prospects for eventual economic extraction has already been proven by current operation.

3.12 Cut-off grade

A cut-off grade of 0.2% CuT has been used for Mineral Resource reporting purposes. The current mine designs have not used any specific cut-off grade and the Mineral Reserve reporting has been based on average grade of mineralised material within designed increments. However, it is noted that on

The cut-off grade, expressed as Cu Equivalent (EqCu) per tonne of rock, was calculated using the following formula:

Cut-off Grade (CuEq%) Breakeven = (Mining Cost ($/t) + Milling Cost ($/t) + Admin Cost ($/t))/(Cu Price ($/lb) – Penalties ($/lb)) * Recovery factor * lb to Mt factor)

Cut-off Grade (CuEq%) = (1.44 + 6.33 + 1.2)/(2.74 – 0.73) * 0.82 * 2204.62 = 0.25%

Cut-off Grade (CuEq%) Marginal = (Milling Cost ($/t) + Admin Cost ($/t))/(Cu Price ($/lb) – Penalties ($/lb)) * Recovery factor * lb to Mt factor)

Cut-off Grade (CuEq%) = (6.33 + 1.2)/(2.74 – 0.73) * 0.82 * 2204.62 = 0.21%

Accounting for the Mo% and Ag g/t components in the CuEq cut-off a breakeven cut-off grade of 0.2% CuT is supportable.

3.13 Environmental factors and assumptions

JORC 2012's states that requirement of reasonable prospects for eventual economic extraction also extends to environmental factors and assumptions. The assumptions are related to the possible waste and process residue disposal options. As a result, classification and definition of the Mineral Resource requires an understanding of the potential environmental impacts of the mining and processing operation.

All the required mining and processing permits are in place. In November 2012, Behre Dolbear Asia carried out an update of their April 2012 Independent Technical Review ITR). The focus was primarily on social, permitting, and environmental issues. Golder is not aware of any high risk environmental issues. The only outstanding issue is the resettlement of small number of residents remaining behind in the old town of Morococha. This is currently being managed at mine level.

Golder believes that the overall risk to the project value is low.

3.14 Block model post-processing

The Toromocho block model is a model constructed by proportion of each geology code and estimation domain code for each block. The following post processing steps were carried out;

- Un-estimated blocks within the LIG were assigned default grades equal to the median value of pass 3 and 4 estimates and also were assigned pass 5 for easy identification.
- Additionally all blocks corresponding to Colluvium were assigned detection limit values.
- The final estimates for each blocks were calculated by proportion weight of each domain category.
- CuT estimates re-adjusted using the following approach to Cus (i.e. CuAS + CuASCN) if the CuT estimate exceeds the CuS estimate;

$$If \qquad \text{“CuS} > \text{CuT”}$$

$$\text{Asignar:} \quad \text{CuSf} = \text{CuT}$$

$$\text{CuASf} = \frac{CuAS}{CuS} * \text{CuSf}$$

$$\text{CuASCNf} = \frac{CuASCN}{CuS} * \text{CuSf}$$

3.15 Resource classification

Mineral Resource classification has been carried out using certain thresholds on estimation errors calculated on the quarterly and annual production parcel sizes. The approach amounts to defining the minimum drill spacing required to achieve certain levels of error of estimations on different size mining volumes (quarterly or annual size parcels). Steps involved are:

- Volumetric analysis of variability using indicator approach with specific cut-off grade
- Preparation of hypothetical data sets representing different drill spacing
- Calculation of kriging variances associated using CuT% variograms and different dill data spacing for various production volume sizes
- Determination of the kriging variance threshold that reflects a specific expected error on a production size volume.

Details of the classification approach is provided in report “*149 215 1105IT017_revB June 2016*”.

Figure 39 provides the calculated theoretical error of estimation using various drill spacing on quarterly and annual size volumes. The two horizontal lines reflect the expected thresholds conforming to Measured and Indicated material.

The relative drill spacing was calculated for each block and converted to an equivalent mesh. The results were visually validated (see Figure 40 left) and subsequently used to arrive with an initial classification of Measured, Indicated and Inferred. Final classification results were smoothed using a 5 m × 5 m × 3 m window. Figure 40 right provides example of the final classification used.

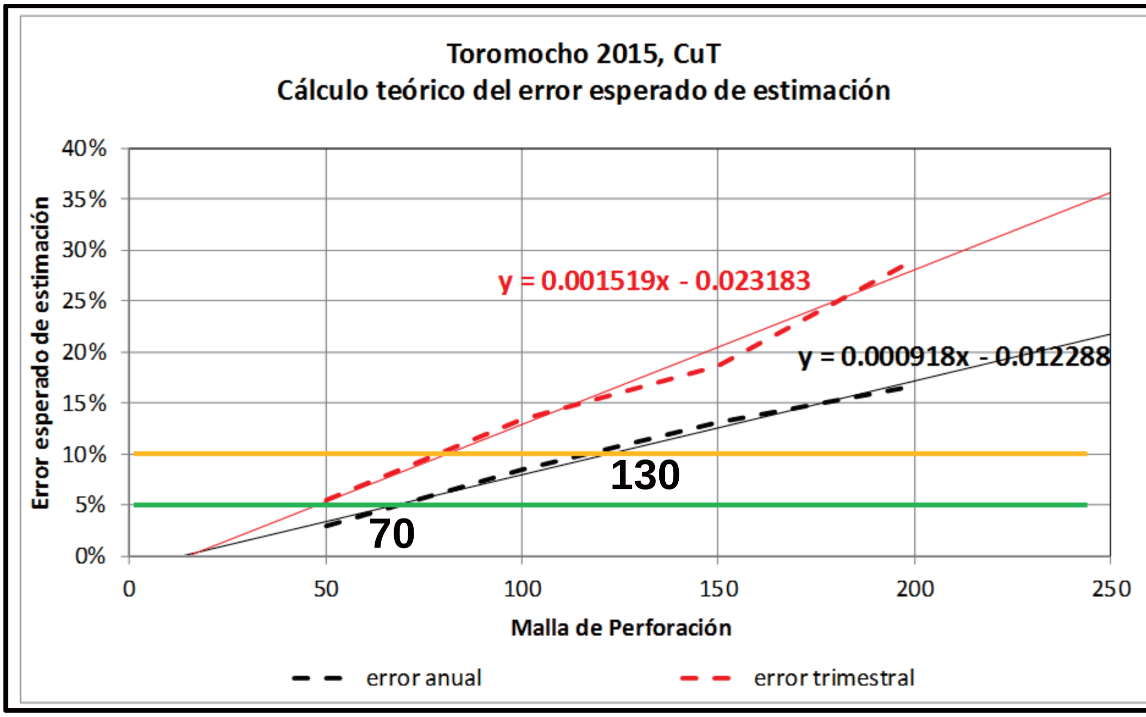


Figure 39: Theoretical error of estimation and the thresholds used for Measured and Indicated

Table 34: Minimum drill spacing thresholds used as a guide for classification to Measured and Indicated

Resource Category	Drill Spacing
Measured	70
Indicated	130
Inferred	LIG

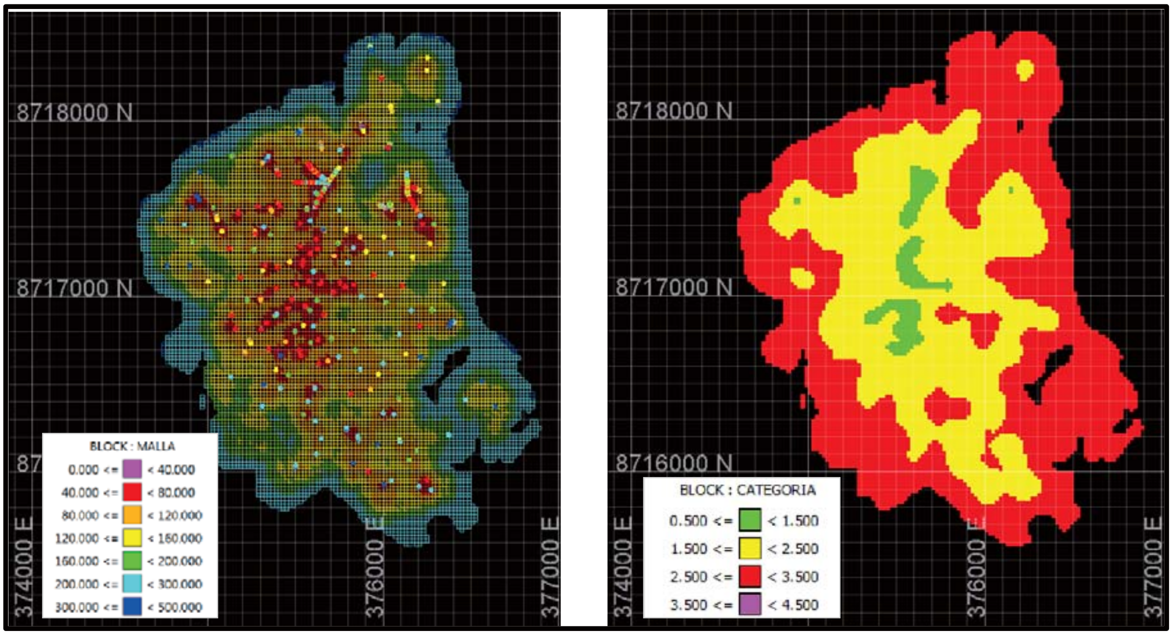


Figure 40: Example plan view of calculated equivalent mesh from block model (left) and final smoothed classification (right)

3.16 Mineral Resource statement

The requirement for reasonable prospects for eventual economic extraction under JORC Code (2012 edition), also necessitates for the Mineral Resources report to be confined to within an economically minable pit limit that satisfies potential future economic extraction.

In order to establish the required economic envelope, a pit optimisation was carried out using Whittle4X® software and the economic parameters provided by Chinalco and documented in "*149 215 1105IT017_revB June 2016*".

The most recent available published Mineral Resources are those declared as part of the Toromocho Project Feasibility Study and last published on the 31st December 2015 in the annual report of the Company. The Mineral Resources were estimated by Independent Mining Consultants for Aker Kavarener as part of the feasibility study. Golder has reviewed the Mineral Resources for the Toromocho Project and is satisfied that the overall methodology employed for the Mineral Resources estimation is in compliance with JORC 2012 requirements.

Table 35 provides a summary of Mineral Resources as at 31 December 2015 mine position using 0.2% CuT cut-off grade. **No account of existing underground workings has been made.**

Table 35: Mineral resources as at 31 December 2015

JORC Measured and Indicated Mineral Resources Category	Tonnes	Grade			Metal Content		
		Copper	Molybdenum	Silver	Copper	Molybdenum	Silver
	(Millions)	(%)	(ppm)	(gpt)	(Mt)	(tonnes)	(tonnes)
Measured	156	0.41	140	6.2	0.64	22,000	1,000
Indicated	364	0.36	120	6.1	1.31	44,000	2,200
Total	**520**	**0.38**	**130**	**6.2**	**1.95**	**66,000**	**3,200**

Mineral Resources are reported as Exclusive of Ore Reserves

JORC Inferred Mineral Resources Category	Tonnes	Grade			Metal Content		
		Copper	Molybdenum	Silver	Copper	Molybdenum	Silver
	(Millions)	(%)	(ppm)	(gpt)	(Mt)	(tonnes)	(tonnes)
Inferred	174	0.46	150	11.5	0.80	26,000	2,000

Mineral Resources are reported as Exclusive of Ore Reserves

4.0 MINING

4.1 Introduction

The Toromocho Project is located in central Peru, approximately 140 kilometres (km) east of Lima, Peru in the Morococha mining district, Yauli Province, Junin Department. The area adjacent to the Toromocho mine is presently being worked by the Pan American Silver company at its Morococha underground silver mine. The Yauli province has a history of silver mining going back many decades (Section 2.3) that has provided the area with a comprehensive infrastructure of paved roads and a primary rail link.

The paved main highway from Lima passes through Morococha. The region has steep topography with elevations over the deposit ranging from 4700 metres (m) to over 4900m above sea level. The valleys in the area are of glacial origin.

The centre of the Toromocho deposit is about 2.5 km from the town of Morococha in the Morococha mining district. Lima to Morococha is about 142 km by road and about 173 km by rail. The former copper smelter plant at La Oroya is no longer in operation, although at the time of the feasibility study it was anticipated that the La Oroya smelter may have been able to take some of the copper concentrate from Toromocho. Concentrate from the Toromocho mine is now exclusively railed to the coast using the central railway (Figure 41).

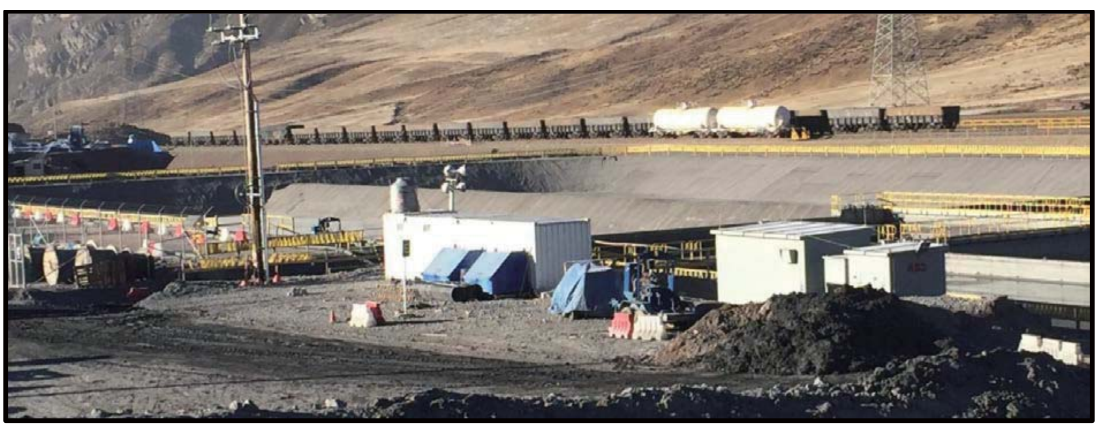


Figure 41: Train loaded with concentrate on central railway line adjacent to Toromocho processing facility

Waste stripping and ore processing commenced in December 2013 following the construction of mining access and the completion of the processing plant facilities. Tonnage ramp-up at the process plant has been relatively rapid since June 2015, although throughput rates are impacted negatively if the Potassic ore zone is not adequately fragmented at the blasting stage. The Potassic is notably harder than the Skarn or Hornfels ore zones and requires a markedly higher blasting powder factor and smaller drill pattern to ensure satisfactory throughput rates through the SAG mill and Ball Mills.

4.2 Mine planning

In 2015 Toromocho had the Life of Mine estimated reserves reviewed by Tetra Tech using updated cost inputs and price estimated for the optimisation process (Table 36). Long term price forecasts have been used for Gold, Silver and Molybdenum with the final pit shell being selected at a revenue factor (RF) of 0.84. The initial phases within the life of mine represent higher value (lower RF) pit shells within the optimisation.

Table 36: Tetra Tech 2015 Whittle optimisation parameters

Item	Unit	Value
Mined material	US$/t mined	1.1463
Bench Increment per 15m bench	Cents per bench	2.5c

Item	Unit	Value
Mill Processing Cost	US$/t Ore Milled	6.33
General and Administration	US$/t Ore Milled	1.20
Copper Price	US$/Lb	2.74
Molybdenum	US$/Lb	10.00
Silver Price	US$/t.oz	18.00
Payable Copper	CuT %	96.5
Payable Molybdenum	%	100
Payable Silver	%	90
Concentrate grade	%	30
TC/RC and penalties – see Figure 42		

It is noted that the bench incremental mining cost of US 2.5c per 15m bench is in line with expectations for the current diesel price and ultra-class truck in use at Toromocho. The base unit mining cost is some 15% higher than that estimated over the LOM compared to the FS report; however the estimate provided here is more appropriate given the degree of blending required to ensure minimisation of the talc quantity being delivered to the process plant during any period.

Refining and Selling cost parameters for 2015 optimisation inputs

Selling		
TC - Cu		
As in Conc ≤ 0.5 %	US$/dmt conc	107.0
0.5% < As in Conc ≤ 1.0%	US$/dmt conc	180.0
1.0% < As in Conc ≤ 1.5%	US$/dmt conc	230.0
1.5% < As in Conc ≤ 3.0%	US$/dmt conc	270.0
RC - Cu		
As in Conc ≤ 0.5 %	US$/lb Cu pay	0.107
0.5% < As in Conc ≤ 1.0%	US$/lb Cu pay	0.180
1.0% < As in Conc ≤ 1.5%	US$/lb Cu pay	0.230
1.5% < As in Conc ≤ 3.0%	US$/lb Cu pay	0.270
Selling - Cu		
6% of payable	US/lb	0.1586
RC - Ag		
0.5 per oz payable Silver	US/t.oz	0.50
Selling - Mo		
Laboratory	US$/dtm MoO_3	71.0
Logistics	US$/dtm MoO3	50.0
Freight	US$/dtm MoO3	80.0

Figure 42: Tetra Tech 2015 refining and selling cost parameters

The arsenic penalties in concentrate have been handled as both a treatment cost per tonne of concentrate and a deduction per unit price for the copper in concentrate; this reflects the current market position for heavy penalties for arsenic in concentrate. The arsenic in the copper concentrate is believed to be primarily associated with the Enargite mineral (Cu_3AsS_4) and appears to be unevenly distributed throughout the initial mining phases but coincident with relatively high-grade copper zones. For example, the grade tonnage curve within the first two mining phases shows a peak zone of arsenic over a relatively small tonnage of ore but with copper grade in the range of 1% (Figure 43). It would obviously be advantageous to separately stockpile this ore and consider separate processing or blending in with lower Arsenic level ore at a future point in the mine life.

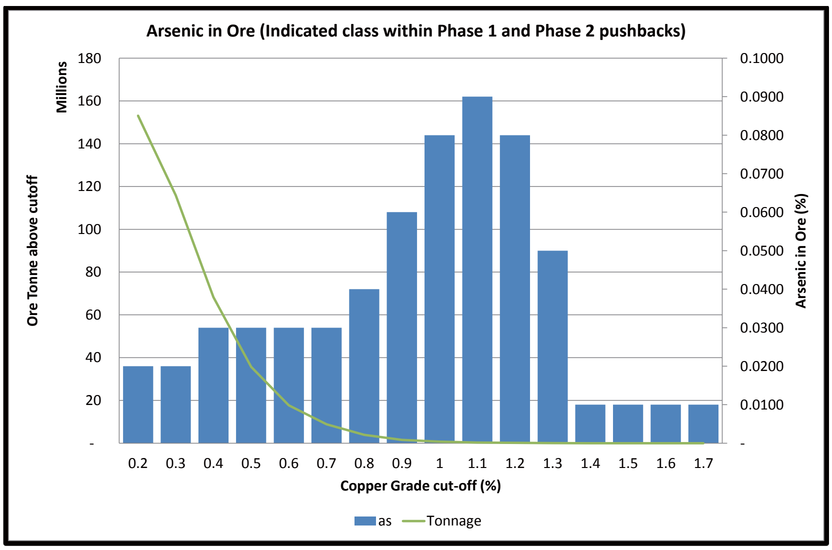


Figure 43: Example of Arsenic levels in ore within phase 1 and 2 by copper grade cutoff

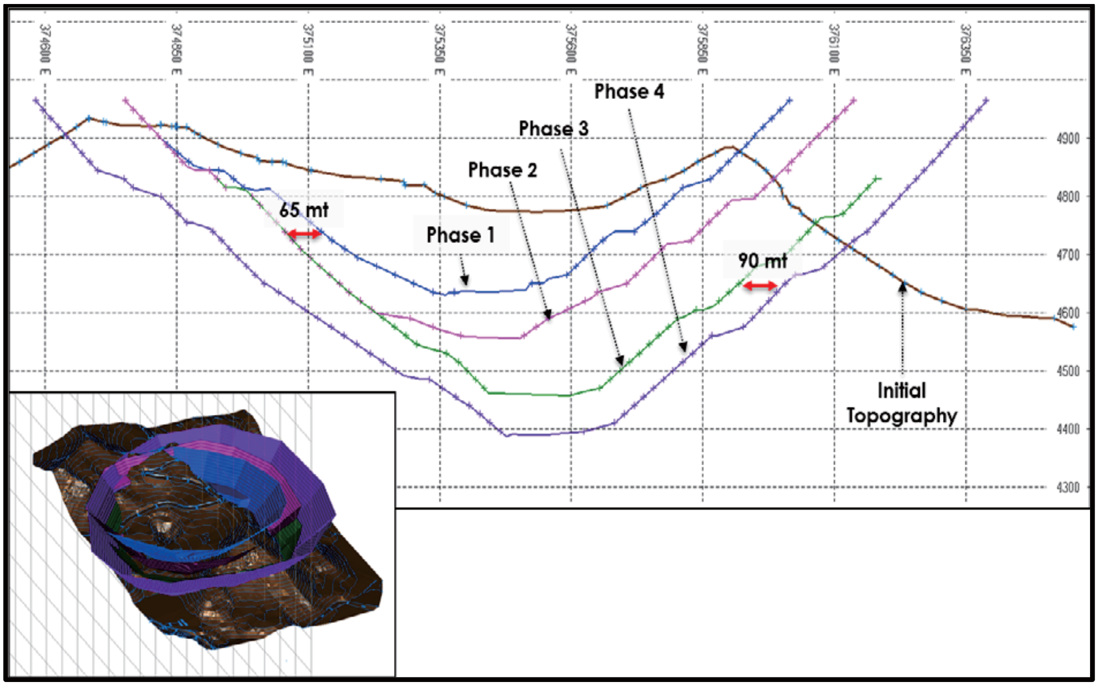
Golder considers that the LOM pit optimisation method and inputs are appropriate and agrees with the methodology and phase selection within the ultimate LOM pit shell. Initial phases within the LOM pit represent markedly lower copper price points than the ultimate pit shell and this provide a degree of flexibility in that all subsequent phases do not have to be committed to at the commencement of operations.

4.2.1 Mine design criteria

The FS report had considered multiple pushbacks or phases within the LOM pit shell as a way of ensuring an adequate available blend of ore types and a practical approach to deferring the waste stripping within the pit.

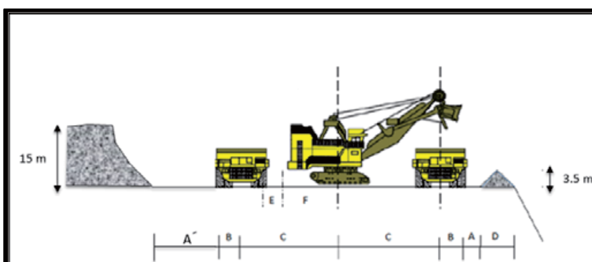
The phasing selected within the FS (Figure 44) appears appropriate; however as has been highlighted by the mine planning department on site some of the phases appear too tight for the size of shovel fleet that has been acquired on the mine. The minimum pushback distance on some of the planned phases is below the 160 m required for a practical pushback width with this size of equipment (Figure 45). It is however normal that for a mine with such a long mine life that detailed phase designs are only produced up to two or three phases in advance as geotechnical and structural information will continue to evolve as the mining operations progress.

Golder would agree that a planned minimum practical overall pushback width of 200 m would be appropriate for this class of equipment to ensure efficient and safe loading operations, with a minimum panel width of 80 m being required for the loading operations on any panel.



Source: 160202 REVISION PLAN IMC R4.pptx

Figure 44: FS phase widths for Toromocho



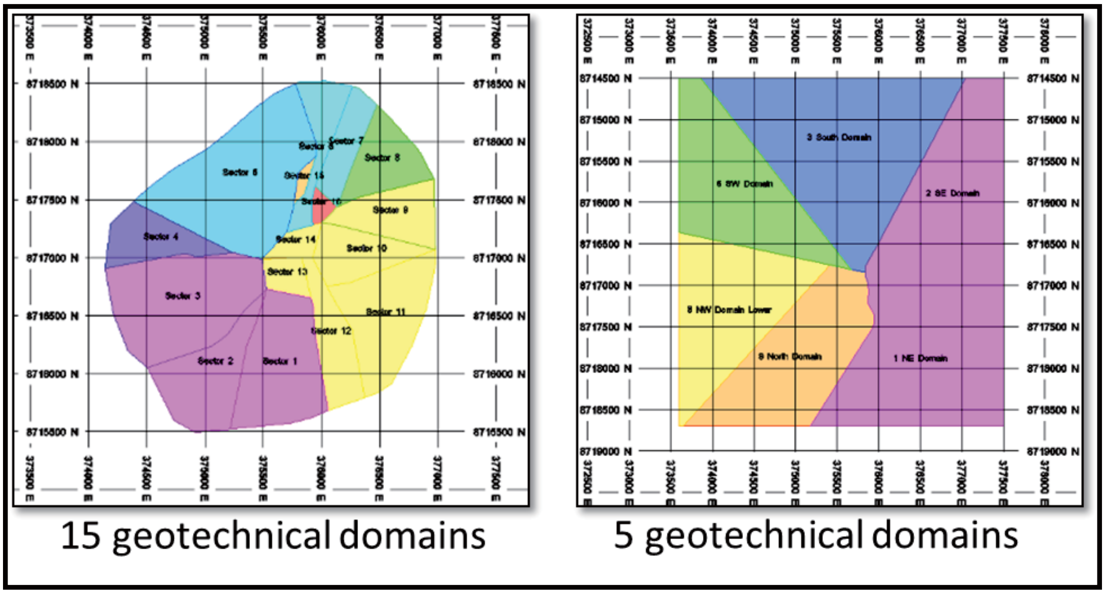
MINING OPERATING WIDTH (CAT 7495 SHOVEL)	
A': Safety distance from slope	12 mt
A: Safety distance from security wall	4 mt
B: Half of haul truck width	5 mt
C: Shovel discharge width	22 mt
D: Security wall width	7 mt
TA: Total mining width (both side loading)	**80 mt**

Source: 160202 REVISION PLAN IMC R4.pptx

Figure 45: Minimum panel width for Cat' 7495 rope shovel

4.3 Geotechnical

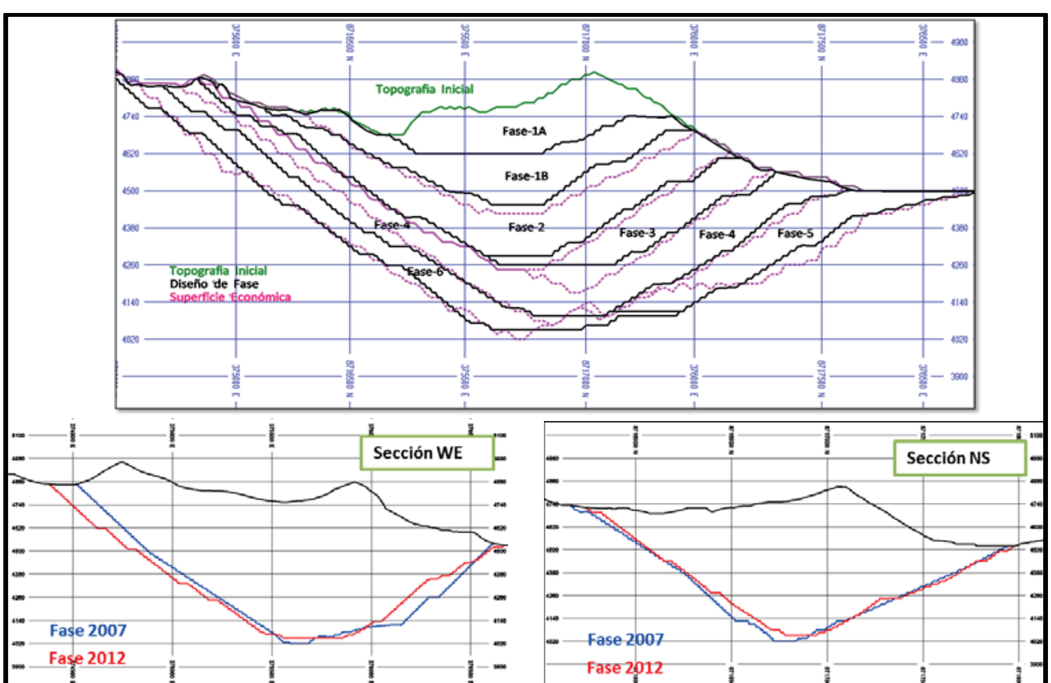
In 2014, the number of geotechnical zones associated with the open pit was reduced from 15 separate zones to five geotechnical zones (Figure 46). The simplification of the geotechnical zones into five regions simplifies the planning and design process for the pit walls.



Source: "160202 REVISION PLAN IMC R4.pptx"

Figure 46: Simplification of geotechnical zones at Toromocho open pit

The overall changes resulting from the updated geotechnical zones necessitated re-design of the pit phases; however comparisons between the 2007 mine design phases and the updated 2014 mine design phases show a minimal change with some ore losses and some ore gains (Figure 47).

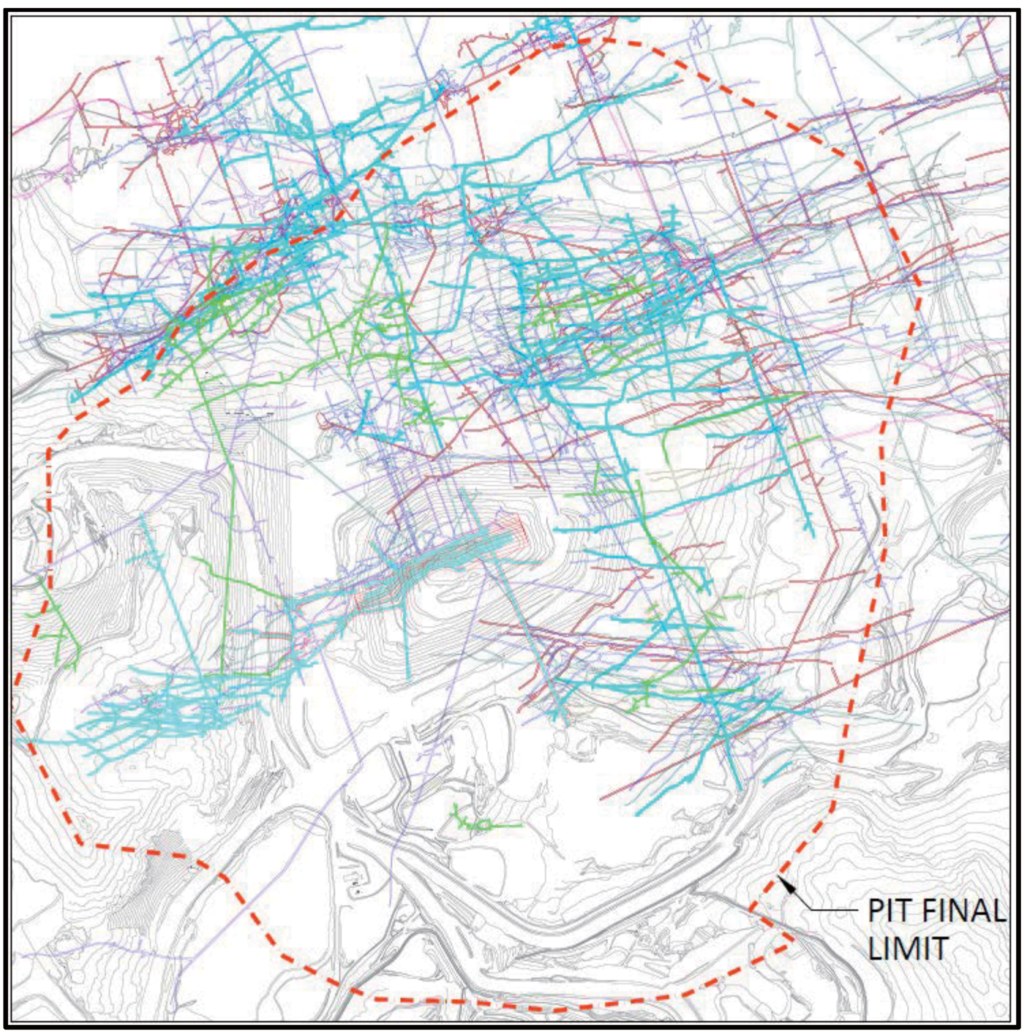


Source: "160202 REVISION PLAN IMC R4.pptx"

Figure 47: Toromocho phase redesigns 2007 c/w 2014 updated designs

Golder believes that the geotechnical slope parameters established by CNI are appropriate and have been derived from adequate due process. As further information is obtained with progressive mining, the design parameters will continue to be reassessed and adjusted accordingly throughout the mine life. Localised failures, particularly within the Skarn material can be expected and early identification and careful monitoring of these regions will be required to ensure operator and equipment safety.

An issue that will require careful ongoing management over the life of the operation is the presence of historical underground workings from the silver mining that has been executed in that area. Many of the historic workings directly intersect the planned open pit (Figure 48). Particular care with regard to void management is needed to protect equipment and personnel. Void management plans and working procedures for the approach to or working through pre-existing underground workings will require ongoing enforcement and careful management. One additional point of note is the increased probability of scrap steel entering the ore stream when mining through old workings. Small items such as roof-bolts and relatively small pieces of scrap metal cannot readily be seen in the blasted ore piles and do not always get collected by the belt magnets or picked up by the over band metal detectors on the conveyor belts.



Source: "GESTION DE RIESGOS GEOTECNICOS EN MINA JUNIO 2016.pptx"

Figure 48: Historic underground workings on edge of Toromocho open pit

4.4 Production scheduling

The updated LOM plan from 2015 (Figure 49) shows a planned ore feed in line with current plant capacity and from 2019 onwards the expanded plant capacity is assumed.

Total material moved remains relatively consistent over the period of 2018 to 2029 approximating some 155Mt p.a. total movement. However there is a requirement to stockpile and reclaim some 325Mt of ore over the LOM plan. The stockpiling includes some 169Mt of 'complex' (high-As) ore. The high-As ore presently results in high penalty costs within the treatment and refining costs at the downstream smelter. Consideration to alternative processing methods for the high-As ore has been highlighted during the FS and further work is envisaged in this regard.

		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
ORE TO CRUSHER																	
Tonnage	**Ton**	42,779	46,511	62,013	62,184	62,014	62,014	62,014	60,184	62,013	62,012	62,015	62,184	62,015	62,014	62,012	62,182
Cu	%	0.610	0.620	0.600	0.600	0.600	0.600	0.601	0.494	0.483	0.483	0.489	0.481	0.504	0.455	0.310	0.394
Ag	gr/Ton	6.42	7.19	6.20	5.71	5.42	5.75	6.05	7.11	6.51	6.42	6.04	5.49	5.52	5.65	6.58	5.52
Mo	%	0.015	0.012	0.018	0.021	0.024	0.025	0.029	0.021	0.020	0.013	0.015	0.019	0.028	0.026	0.029	0.014
WASTE																	
Tonelaje	**Ton**	50,873	52,617	16,353	19,938	43,223	46,040	62,998	81,039	72,232	62,771	73,860	86,292	53,960	61,992	32,541	37,196
TOTAL PRODUCTION																	
Tonelaje	**Ton**	93,652	99,128	78,366	82,122	105,237	108,055	125,012	141,223	134,245	124,783	135,875	148,476	115,975	124,007	94,554	99,379
ORE TO MID-GRADE STOCK																	
Tonnage	**Ton**	2,122	11,125	18,369	28,401	13,220	19,797	3,431						21,809			
Cu	%	0.361	0.391	0.389	0.399	0.386	0.387	0.340						0.788			
Ag	gr/Ton	4.893	5.329	5.216	5.549	4.679	4.131	4.238						7.596			
Mo	%	0.011	0.008	0.008	0.012	0.009	0.015	0.018						0.030			
ORE TO LOW-GRADE STOCK																	
Tonnage	**Ton**	15,181	34,258	45,180	28,258	26,308	15,803	13,635	8,439	14,727	25,637	16,118	4,945	11,667	5,976		
Cu	%	0.277	0.297	0.293	0.302	0.291	0.303	0.265	0.204	0.229	0.277	0.280	0.250	0.223	0.203		
Ag	gr/Ton	4.730	3.935	4.087	4.212	3.886	3.363	5.102	4.696	4.244	3.944	3.092	1.749	3.081	3.241		
Mo	%	0.006	0.005	0.007	0.008	0.008	0.009	0.008	0.008	0.011	0.009	0.007	0.012	0.024	0.015		
HIGH ARSENIC STOCK - NOT CONSIDERED IN ORE RESERVES																	
Tonnage	**Ton**	5,115	10,249	12,845	16,403	9,995	11,104	12,682	5,522	5,788	4,340	2,767	1,763	5,309	4,777	943	3,573
Cu	%	0.705	0.608	0.569	0.515	0.644	0.647	0.455	0.453	0.460	0.641	1.054	1.038	0.539	0.344	0.329	0.338
Ag	gr/Ton	11.923	14.748	14.657	14.293	17.039	14.693	13.409	14.103	11.077	13.085	17.192	11.914	12.353	10.168	6.202	9.291
Mo	%	0.016	0.013	0.011	0.008	0.015	0.021	0.010	0.012	0.020	0.009	0.010	0.018	0.031	0.014	0.010	0.014
TOTAL MINED MATERIAL																	
Tonelaje	**Ton**	116,070	154,760	154,760	155,184	154,760	154,760	154,760	155,184	154,760	154,760	154,760	155,184	154,760	108,730	85,467	69,063
TOTAL MOVED MATERIAL																	
Tonelaje	**Ton**	116,070	154,760	154,760	155,184	154,760	154,760	154,760	155,184	154,760	154,760	154,760	155,184	154,760	134,760	95,497	102,952

Source: 150118 Plan de Minado LOM EXP 2018.pptx

Figure 49: Summary material movement

Golder notes that the total required stockpiling capacity of some 325 Mt in three or more distinct locations will require a large footprint and careful management to avoid contamination and dilution.

From the 2007 FS designs through to 2016 there have been minor changes to the overall pit designs with the majority of modifications being targeted at improved geotechnical stability and achieving practical stage access. The most current revisions to the mining phases have been carried out by Tetra Tech in 2016. There are in total nine (9) phases designed for the Toromocho deposit over the mine life. The Ore Reserves (31st December 2015) contained within the final LOM pit amounts to 1 593 Mt of Proven and Probable classifications at a head grade of 0.459% Cu, 5.78 g/t Ag, and 0.017% Molybdenum (*source: "Informe Etapa II Estimación de Reservas Mina Toromocho_Rev0.pdf")*. There is an additional 130 Mt of Inferred Resource material contained within the LOM pit that may be converted to Indicated or better and has not been included within the Ore Reserves. The Tetra Tech mining study completed in December 2015, has to date not been published. Golder believes that the Tetra Tech study presented updated parameters to the IMC 2007 study, with the Tetra Tech study presenting a similar ore reserves albeit more favourable estimate to the IMC 2007 estimate. As the Tetra Tech study result is not published, Golder is of the view that it is acceptable and correct to use the Mineral Resources and Ore Reserves as declared in 2015 (based upon the 2007 study) as 1) it is in compliance with the JORC 2012 standard and 2) it shows a more conservative estimate when compared to the 2015 mining study.

The most recent available published Ore Reserves are those declared as part of the Toromocho Project Feasibility Study and last published on the 31st December 2015 in the annual report of the Company. The Ore Reserves were estimated by Independent Mining Consultants for Aker Kavarener as part of the feasibility study. Golder has reviewed the Ore Reserves for the Toromocho Project and is satisfied that the overall methodology employed for the Ore Reserves estimation is in compliance with JORC 2012 requirements.

Table 37: Toromocho Ore Reserves at 31 December 2015

JORC Ore Reserve Category	Tonnes (Millions)	Grade			Metal Content		
		Copper (%)	Molybdenum (ppm)	Silver (gpt)	Copper (Mt)	Molybdenum (tonnes)	Silver (tonnes)
Proved	690	0.51	200	6.4	3.53	138,000	4,400
Probable	784	0.43	180	7.3	3.40	141,000	5,700
Total	**1,474**	**0.47**	**190**	**6.9**	**6.93**	**279,000**	**10,100**

The Ore Reserves for Toromocho have been estimated by Independent Mining Consultants using an industry-recognised methodology and approach.

Golder supports the Ore Reserves for the Toromocho project as declared at 31st December 2015.

A summary of the ore within each phase (Figure 50) shows that as would be expected the proportion of lower grade material is greater in the initial phases, this is a result of the later phases specifically targeting the deeper seated ores within the pit. The high-As level ores however do appear to be distributed more evenly throughout the mining phase and result in an average of some 10.6% of total ore contained within the LOM pit. Given the apparent dispersed nature of the high-As ore throughout the mining phases, adequate stockpiling capacity or an alternative treatment method will be required throughout the LOM.

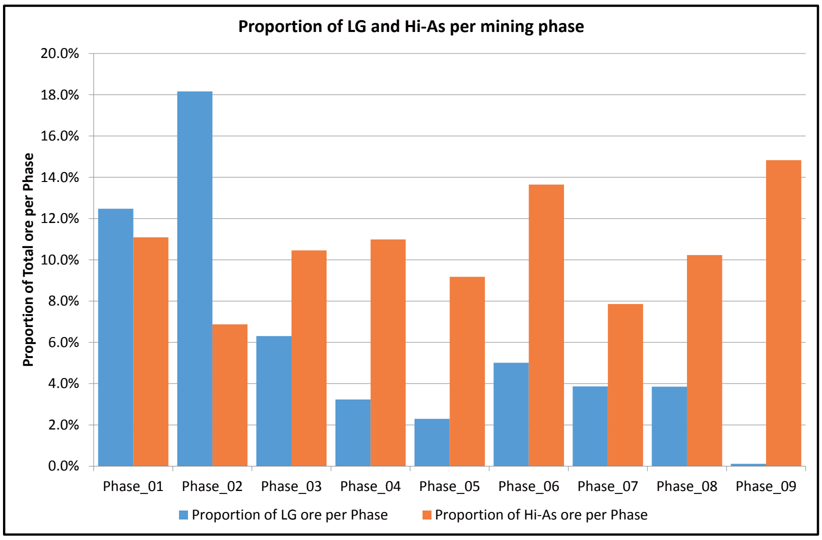


Figure 50: Proportion of high-arsenic ore and low grade ore per mining phase

Tetra Tech in their 2016 has provided a breakdown of the Ore Reserves within the LOM pit for the first six (6) mining phases. The direct feed ore being targeted within the first six phases represents a higher average grade than for the LOM average. Phases 1 through to 6 deliver on average an 11% higher copper equivalent grade to the mill when compared to the total LOM phases 1 through to 9. Golder recognises that targeting the higher grade ore in the initial portion of the mine life will assist in maximising the opportunity to recover capital costs and improve NPV. The average direct feed ore grade (CuEq %) per mining phase along with the ore tonnage for direct feed per phase is shown in Figure 51 below.

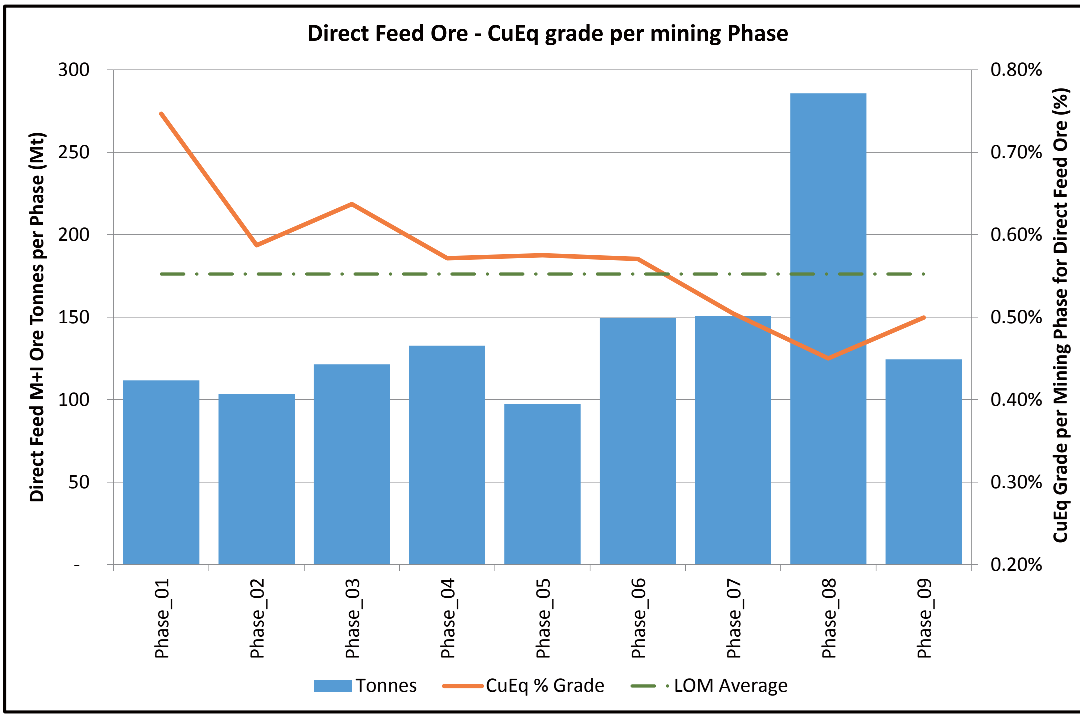


Figure 51: Direct feed ore CuEq grade per phase with phase tonnage

The planned annual material movement over the LOM remains fairly constant at 128 Mt over the period 2021 through to 2036 and then declines over the remainder of the LOM as ex-pit waste material movement is exhausted (Figure 52). The average planned daily movement equates to some 350kT with the daily movement requirements only declining after 2036 (Figure 53).

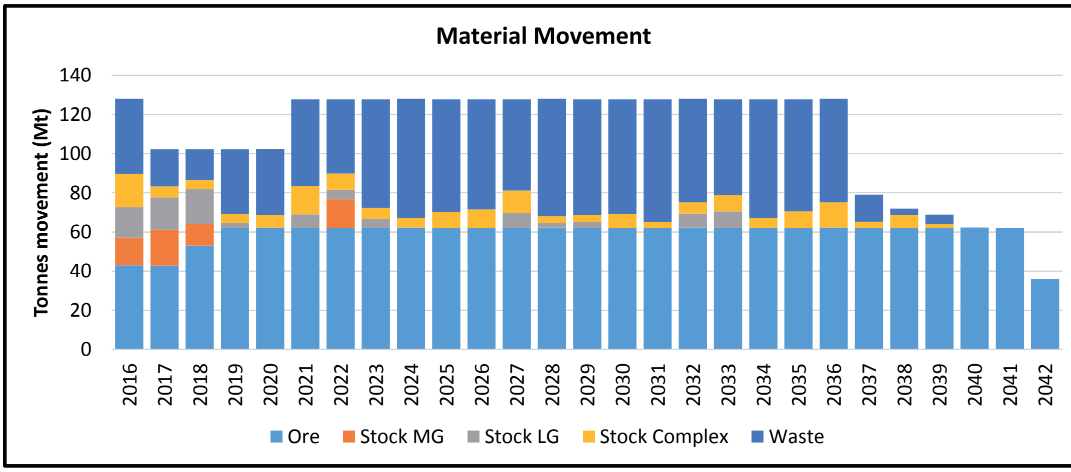


Figure 52: Planned total material movement over LOM for Toromocho project

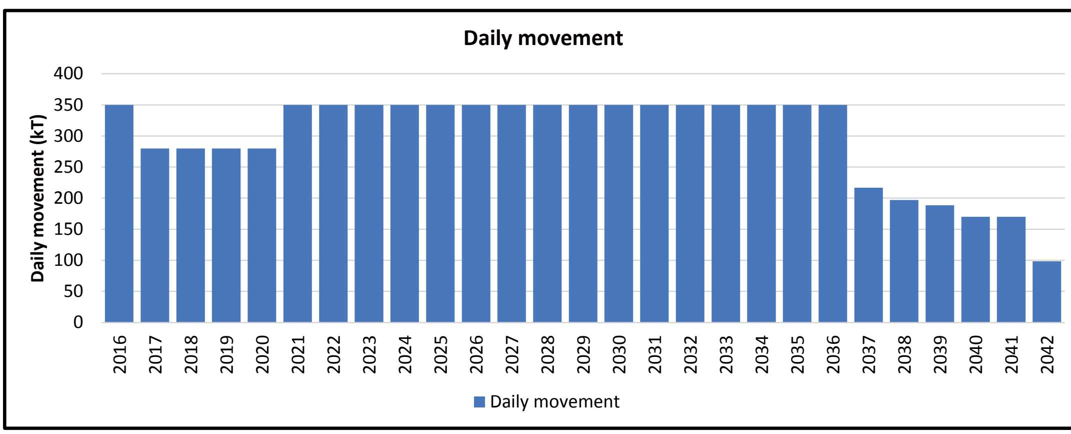
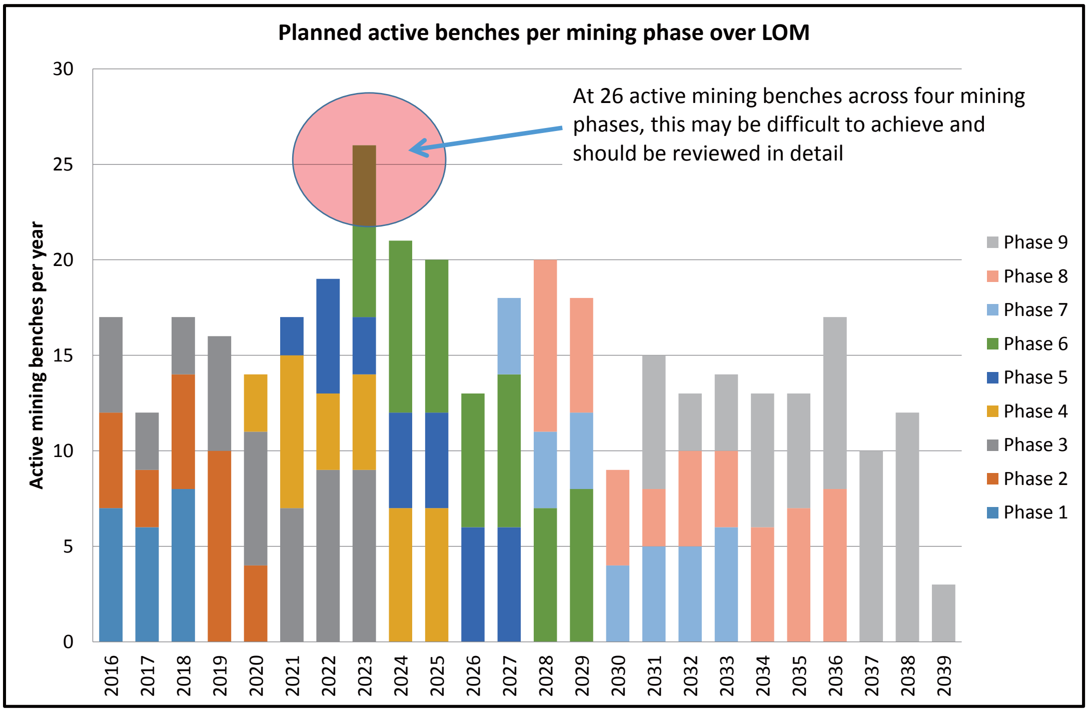


Figure 53: Planned daily material movement over LOM for Toromocho project

Golder believes the planned movement per year is achievable but has some reservations about the ability to meet the blend requirements in order to reduce the level of talc in the mill feed over a shorter (daily) period. It is possible that additional loading capacity may be required at a lower utilisation to ensure that the ore blend ratios are optimised for maximum process plant throughput and metallurgical recovery.

The bench sink rate appears achievable at a maximum of 10 benches per year per mining phase; however, there is a period within the schedule (2023) when four active phases are being targeted in the same year. Golder believes that this may be ambitious and would recommend that the practicality of achieving this plan be assessed in detail to confirm that the equipment resourcing is adequate (Figure 54).



Source: Tetra Tech 2016

Figure 54: Planned bench sink rate per year per mining phase

4.5 Mining operations

The Toromocho Mine is a conventional large scale open pit mine. The ore and waste rock is drilled and blasted prior to excavation by electric rope shovel excavators. The ore is loaded into ultra-class diesel powered off-highway rigid dump trucks (Cat' 797) and hauled to either stockpile, or dumped directly into the primary crusher. The waste rock is hauled to the western waste dump. The mining fleet is owned and operated by Toromocho Mine. The general layout of the mining operations can be seen in Figure 55 below.

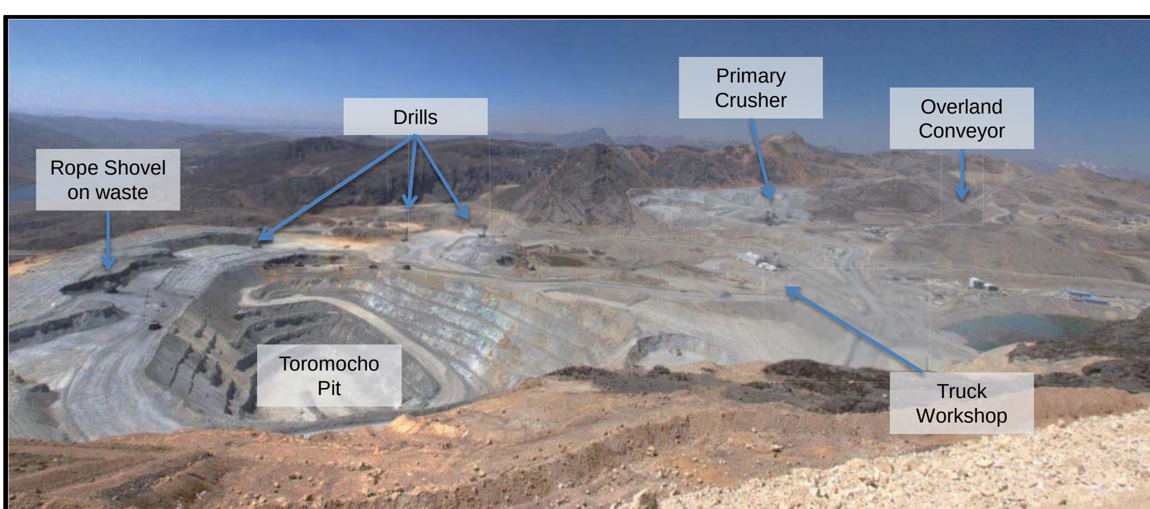


Figure 55: Toromocho mining operations – July 2016

4.5.1 Grade control and blast design

The grade control at the Toromocho Mine utilises the blast holes chips for sampling and analysis of the ore zone. An 8 kg sample from the collar of the drill cone is collected from a minimum of 10 stab-holes at various points around the drill collar. The sampling procedure for blast hole grade control sampling at Toromocho is shown below in Figure 56.

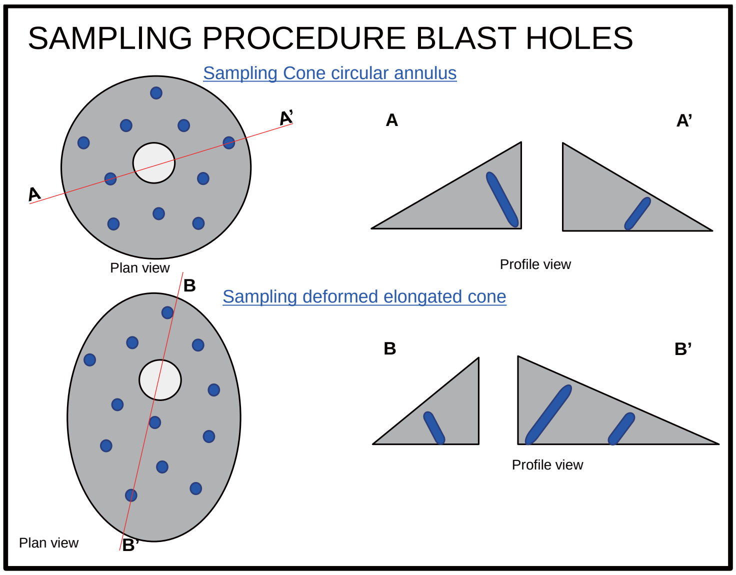


Figure 56: Toromocho grade control sampling procedure – 2016

The blast hole samples are analysed by the SGS laboratory on site with the results being fed into an Mine Sight (MS) Axis database to ensure integrity of results and minimal transcription errors. The MS Axis database is then used to populate the short-term block model used for daily and weekly production forecasting.

Golder believes that with the current practices and systems the mine should be able to reasonably accurately forecast the grade and material characteristics (e.g. Talc and Arsenic content) prior to excavation of the ore. The grade control methodology using blast-holes is viewed as being an accepted industry practice for this type of operation, but is also known to results in significant misclassification of ore to waste.

Golder would recommend giving consideration to dedicated grade control drilling ahead of the blast-hole drilling. Grade control drilling is felt to offer a greater degree of grade certainty and prediction modelling.

4.5.2 Drilling and blasting

Blast hole drilling operations at Toromocho are conducted using three large electric Pit Viper 351 blast hole drilling rigs. The drills are capable of drilling up to a ± 20 m depth as a single-pass at 350 mm diameter with some 56.7 t of bit loading.

All blast holes are loaded with bulk emulsion explosives that are mixed on site by the local explosives contract provider. The blasting contractor supplies all explosives and blasting accessories for each blast. Blasting patterns in the Skarn and Hornfels is on a 6.9 x 8.0 m staggered pattern. The Potassic material is much harder than either the Skarn or Hornfels and achieves optimum fragmentation at a 5 × 6 m staggered pattern. Larger burden and spacing patterns in the Potassic do reportedly result in reduced SAG Mill and Ball Mill throughputs hence increased secondary overall breakage costs.

The pit position as at July 2016 is shown in Figure 57 with the Electric shovels PL01 and PL03 both mining on the 4665 m RL and shovel PL02 mining one bench below on the 4650 m RL.

Critical to achieving maximum recovery of the copper and throughput through the process plant is an optimal blend of Potassic, Skarn and Hornfels that seeks to limit the talc to below 17%. The talc in the Skarn and Hornfels has the effect of preferentially floating and frothing in the concentrate circuit reducing the potential metallurgical recovery. The degree to which talc was present within the Skarn and Hornfels had perhaps not been fully appreciated at the feasibility stage of the project.

The drill and blast activities at the Toromocho Mine appear satisfactory in the Skarn and Hornfels materials.

Golder would however recommend that total liberation cost as opposed to only drilling and blasting costs is considered when adopting blasting patterns in the hard Potassic material. Secondary breakage costs are generally regarded as being an order of magnitude greater than the initial breakage costs incurred with blasting.

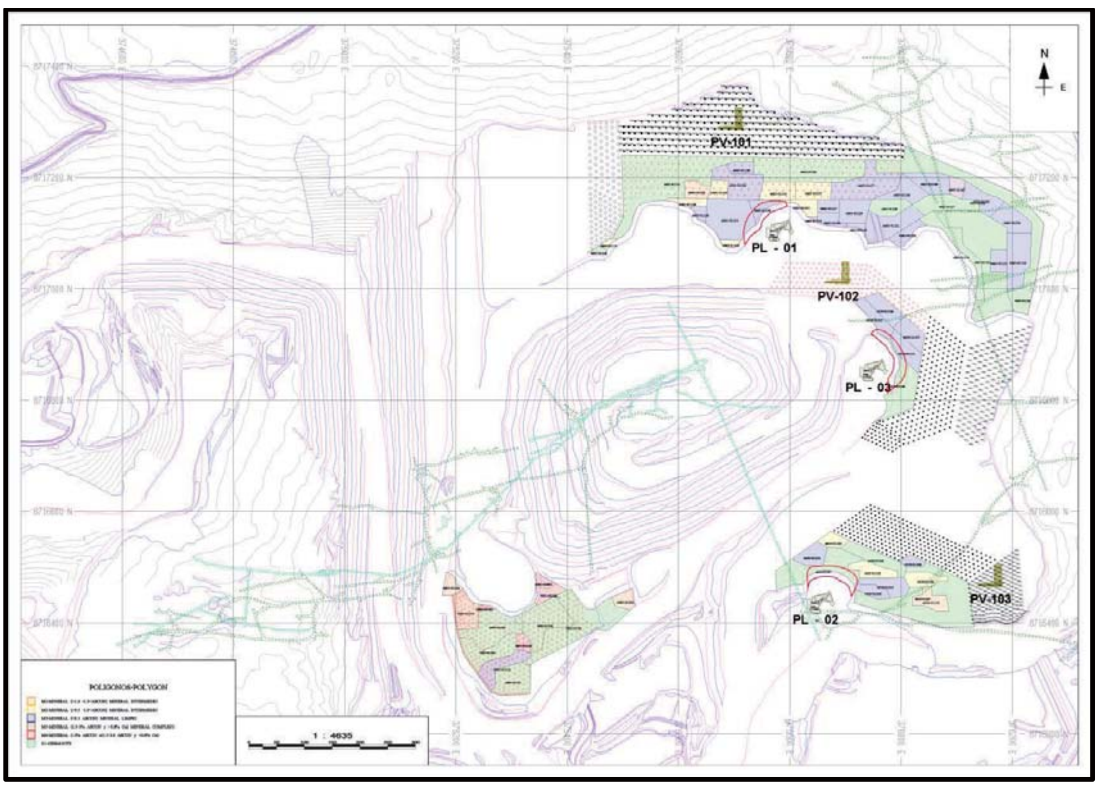


Figure 57: Toromocho Mine position as at July 2016

4.5.3 Loading and hauling

The main loading fleet at the Toromocho Mine are the three 35 cu.mt rope shovels (Cat' 4795) supported by a large Le Tourneau 2350 Front End Loader (FEL). The large FEL provides some degree of blending capability and a fall-back loading capacity.

A view of the general loading operations at Toromocho Mine can be seen in Figure 58 below, with the cable towers used to keep the trailing cable clear of truck traffic clearly visible in the lower right of the photograph.

A summary of the mining production fleet and auxiliary fleet numbers is shown in Figure 59.

The electric rope shovels provide a low unit cost of production and typically have a life expectancy in excess of 20-years. The rope shovels do typically have less flexibility in terms of mobility when compared to a diesel-hydraulic excavator but are ideally suited to large volume long-life operations such as Toromocho.

Figure 58: Loading operations at Toromocho Mine – July 2016

Purchase Order	Description	Real Units	F
	Production Equipment		
M-310	Blasthole Drills (PITVIPER 351)	3	
M-311	Secondary RockDrill (ATLAS COPCO ROCKL8)	1	
M-315	Electric Mining Shovels (CAT 4795)	2	
M-316	Wheel Loader (LT 2350)	1	
M-340	Production HaulTruck&SupportEquipment(CAT 797)	16	
M-340	Production HaulTruck&SupportEquipment(CAT 777)	5	
M-340	Production HaulTruck&SupportEquipment(CAT 992K)	1	
M-340	Production HaulTruck&SupportEquipment(CAT D10T)	6	
M-340	Production HaulTruck&SupportEquipment(CAT 854K)	4	
M-340	Production HaulTruck&SupportEquipment(CAT 24M)	4	
M-340	Production HaulTruck&SupportEquipment(CAT WT777F)	4	
M-340	Production HaulTruck&SupportEquipment(CAT 336D)	1	
M-340	Freight, Duties and Services		
M-340 CO 02	Production HaulTruck&SupportEquipment(CAT 16M)	1	
M-340 CO 03	Production HaulTruck&SupportEquipment(CAT 374DL)	1	
M-340 CO 03	Production HaulTruck&SupportEquipment(CAT 966H)	1	
M-340 CO 03	Production HaulTruck&SupportEquipment(CAT 420)	1	
	Auxiliary and Support Equipment & Others		
M-418	Skid Steer Loader - blasthole stemmer (CAT 246)	2	
M-429	Cat Loader & Truck (CAT 793B)	1	
4500004182	Secondary ATLAS COPCO DM45	1	
4500003514	Compactor Roller (CAT CS76)	1	
M-001	Equipo de mina soporte		
M-221	Skid Steer Loaders	8	
M-341	Loader for tire manipulator	1	
M-341A	Tire Manipulator	1	
M-342	Articulating truck	1	
M-342 & A	Fuel / Lube Truck (3,000 to 5,000 gal fuel tank)	1	
M-343	Training Simulation Machine	1	
M-425	27 Ton Swing Lifts	1	
M-427	Trailer for Skid Steer Loader	1	
M-428	Cat 583T Pipe Layer	1	
PEP: 12-018-7-001-015	015 Tools for Cat 797 HT Atlas PV 351 and auxiliary equipment		
PEP: 13-002-7-001-004	Major Components		
PEP 13-026-7-001-033	777G		

Figure 59: Toromocho summary of forecast major mining equipment – January 2015

4.5.4 Ore crushing and stockpiling

The ore is hauled from the working faces to an ex-pit crushing facility located on the northern side of the pit. Haul trucks dump the high grade ore into one of two rock hoppers which feed the primary crusher (Figure 60). The primary crusher reduces the ore to -150 mm then feeds the broken ore onto a 7 km long overland conveyor belt to the crushed ore stockpile (Figure 61). Ore from the crushed ore stockpile is then fed to the SAG Mill and subsequently to two Ball Mills running in parallel.

Figure 60: Primary crusher with dual access tipping bin – July 2016

Figure 61: Crushed ore stockpile – July 2016

4.5.5 Dispatch and control

All shovel; drill and truck locations within the pit are monitored using the Minestar dispatch monitoring system. The Minestar system enables rapid identification of equipment positions and equipment state. The blast loading areas are electronically uploaded into the Minestar system to enable the shovel operator to track the ore type and waste material positions within the blast for loading. A typical ore and waste blast region can be seen in Figure 62 below. The yellow regions are Low-grade ore (M2), the blue regions are the medium grade ore (M3), with the orange and yellow being higher grade ore (M1) and grey being waste.

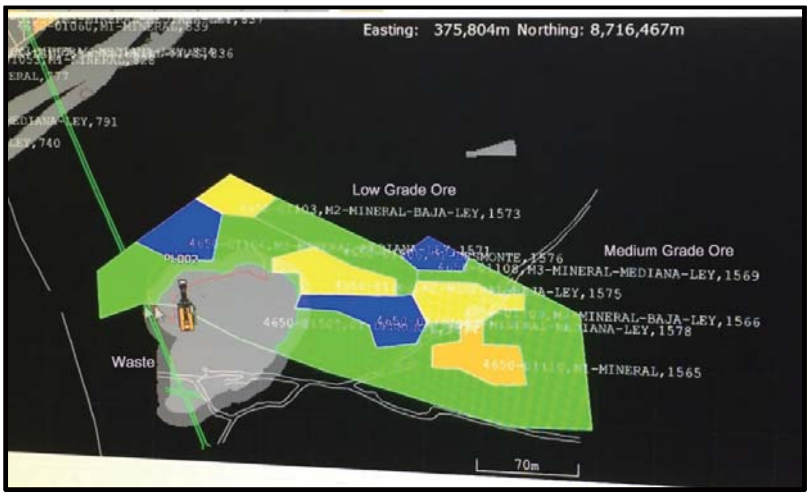


Figure 62: Minestar screen showing ore and waste areas within a blast on the 4650 m RL bench

Also available through the computerised information systems are the current process plant statistics and performance metrics. The primary crusher information is a key tool in enabling the mining department to monitor the crushed ore stockpile levels and ensure sufficient crushed material is available to keep the SAG Mill supplied. The schematic performance metrics for the primary crushing system are shown in Figure 63 below.

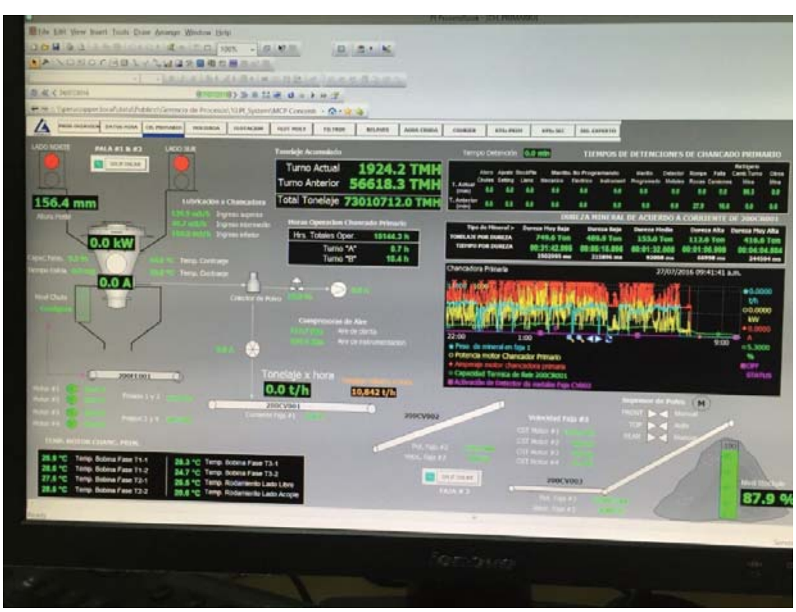


Figure 63: Primary crusher and conveyor system performance measures

The primary crusher has a discharge belt feeder that dumps the ore onto a transfer belt conveyor, which will be equipped with a belt-rip detection system. The conveyor is driven by a 150 kW hydraulic motor and has a removable, permanent magnet installed over the head pulley to collect tramp iron and protect the downstream conveyors.

4.5.6 Maintenance facilities

Toromocho has provided an in pit maintenance facility for the trucks and mobile mining equipment adjacent to the Primary Crusher facilities. The light vehicle workshop and tandem truck bay workshop can be seen in Figure 64. Additional workshop facilities are envisaged as part of the future expansion project for the mine.

Figure 64: Truck workshop and light vehicle workshop facilities – July 2016

4.6 Mine costs and value

The revised planned mining costs for the Toromocho project appear in line with expectations for this type of large volume mining operation. The FS mining costs have been updated in 2016 with the revised mining costs being viewed as more appropriate for the greater degree of blending required than had been anticipated in the FS.

Drilling and blasting costs in the Skarn and Hornfels material appear adequately costed and appropriate. Drilling and blasting within the potassic material will however require a large powder factor and markedly reduced blasting pattern dimensions to ensure the overall lowest cost of total comminution and maximum throughput. It is generally regarded that effective ore breakage at the mining stage by blasting is factor of magnitude less than any subsequent breakage mechanism through the primary crusher or milling circuit. Secondary advantages associated with maximisation of the breakage during the drilling an blasting stage include improved shovel loading rates, reduced stress damage on shovels and trucks, improved mill throughput rates and generally longer equipment life.

In reviewing the Toromocho Project without the expansion option being considered, three scenarios have been considered to provide a range of possible values. The scenarios considered have not factored in the envisaged process plant unit cost savings.

The three scenarios anticipate that the designed metallurgical recovery for copper will be achieved in 2017 but have allowed for reduced metallurgical recovery during 2016. It is possible that further work will be required during 2017 to fully resolve the recovery issues associated with Talc in the ore feed. To this end, Golder is satisfied that the processing department and Toromocho management are fully committed to resolving the remaining issues within the process plant.

Scenario 1 – The project remains particularly sensitive to copper recovery and copper price. Assuming a base LOM long-term copper price of $2.27/Lb, the project, without expansion, does not provide a positive return on investment at the WACC discount rate of 7.31%.

Scenario 2 – Using an assumed seven-year cycle copper pricing option wherein the copper price varies per year over a seven year cycle (Figure 65) appears to produce a modest profit before expansion.

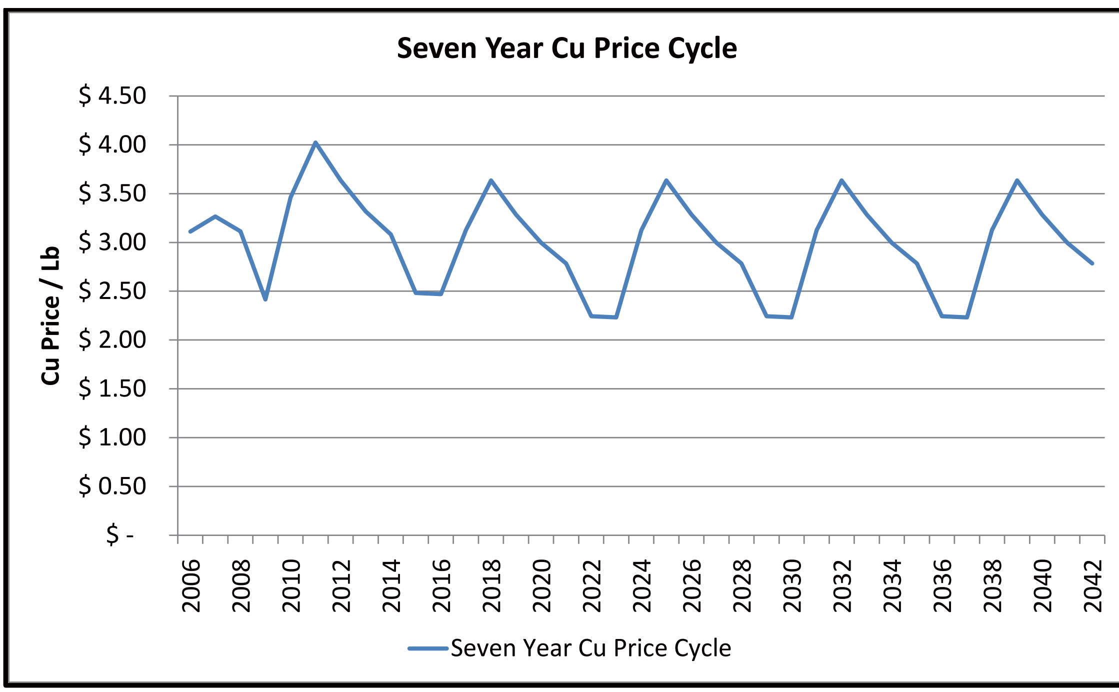


Figure 65: Floating copper price based upon historical price trends

Scenario 3 – Using a strong copper price indicative of an optimistic case, produces a reasonable return on investment; however the likelihood of an early return to a strong copper price would currently appear somewhat remote.

In order to assess the overall project sensitivity to various value drivers the third scenario was used to provide a range of relative values when flexing copper recovery, copper price, mining cost and process cost. The cases considered are summarised in the table below (Table 38).

A summary graph of the results is shown in Figure 66, with the results being largely as expected. The operation is highly sensitive to changes in the Copper Price, followed by Process plant unit cost and less sensitive to changes in Mining unit cost or modest changes in process recovery. It is important to note that the base copper recovery level of 85% has been assumed to be realised from 2017 onwards and that flexing of the copper recovery was relative to this base recovery level.

Table 38: Value drivers sensitivity for Toromocho Project

Scenario	Plant Recovery	Copper Price	Mining Cost/t	Process Cost/t
Pessimistic	-4% recovery	-10% change	+10% change	+10% change
Poor	-2% recovery	-5% change	+5% change	+5% change
Norm	Nil change	Nil change	Nil change	Nil change
Good	+2% recovery	+5% change	-5% change	-5% change
Optimistic	+4% recovery	+10% change	-10% change	-10% change

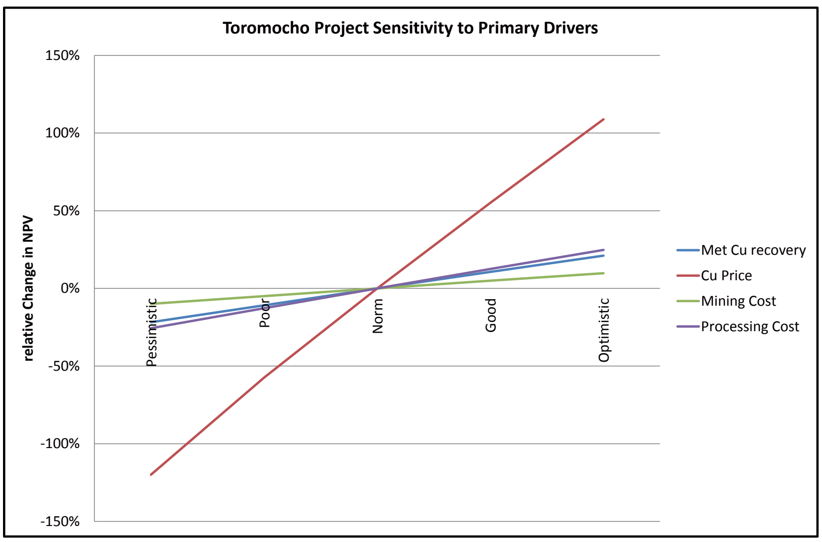


Figure 66: Relative change in value of Toromocho Project – without expansion case

Golder notes that capital cost of establishing the Toromocho project has added a significant financial burden to the overall project value, using the current valuation model and a cyclical copper pricing mechanism do not appear to show a satisfactory level of return without the expansion option.

Golder would recommend that prior to any commitment to an expanded option that the expansion option is again fully costed and that any process or operational modifications identified during the current non-expanded phase are incorporated into the expanded case accordingly.

The Toromocho project appears moderately sensitive to process cost and process recovery and relatively insensitive to mining costs.

Golder has compared both the Mining costs and the Processing costs with similar scale and type of operations know to Golder and considers the LOM cost estimates to be reasonable. Golder does however believe that the mining unit costs may be slightly understated given the likelihood that a greater degree of ore blending will be required than had been assumed to be the case with the FS. As the project is relatively insensitive to mining costs, this would be expected to have minimal effect on the overall value of the project.

Unit process costs are largely driven by the achieved throughput in that a large proportion of the processing costs are relatively fixed in nature, thus achievement of both throughput and recovery levels within the processing section are fundamental drivers of project value.

4.7 General comments on LOM plan

In considering the option of the Toromocho Expansion phase of the project, it may be prudent to defer the expansion stage until the current concentrate process plant has achieved nameplate recovery efficiencies. A complete understanding of the blend requirements and process modifications required to maximise the copper recovery are fundamental value drivers within the Toromocho project.

The estimated value improvement from the Expansion case has been tabulated from the TEP Financial Model (*Morgan Stanley – "TEP Financial Model – Basis 20160607.xls"*). The TEP FinModel indicates that the throughput expansion reduces the on-mine equivalent copper production cost from $1.27/Lb to $1.21/Lb.

The cost of finance and employee profit sharing has been excluded from the above totals in order to provide a direct comparison of on-mine costs. As would be expected with any process expansion option, the unit cost of metal production is the largest potential area of cost reduction. However it is probably the largest area of risk in regards to capital cost and achievement of design parameters. The expansion option does appear to offer a marked benefit to the Toromocho project; however it is believed that the timing for the expansion should be reviewed.

A breakdown of the cost of copper production per cost area for the TP and the TEP case is shown in the Table 39 below and presented as a graph in Figure 67. The process plant area accounts for some 55% of the cost of on-mine production costs. Ensuring that the process plant has achieved full nameplate design could be viewed as being a critical milestone prior to a decision concerning the further expansion opportunity.

Table 39: On Mine cost of copper production per Lb (source TEP FinModel)

Cost Area	TP Case	TEP Case	TEP Vs TP
	Cost/Lb Cu recovered	Cost/Lb Cu recovered	Variance ($/lb)
mine	$0.24	$0.24	-
reclaim from stockpile	$0.01	$0.02	0.01
process plant	$0.70	$0.68	-0.02
Moly Production	$0.05	$0.06	0.01
Kingsmill	$0.01	$0.01	-
On-Site Adm and General Services	$0.13	$0.11	-0.02
Transportation, Freight and Warehouse	$0.00	$0.00	-
Administration Expenses	$0.03	$0.03	-
Legal, Permit and Community	$0.02	$0.01	-0.01
Centromin royalty	$0.04	$0.04	-
Insurance	$0.03	$0.02	-0.01
Total cost/Lb Copper	**$1.27**	**$1.21**	-0.06

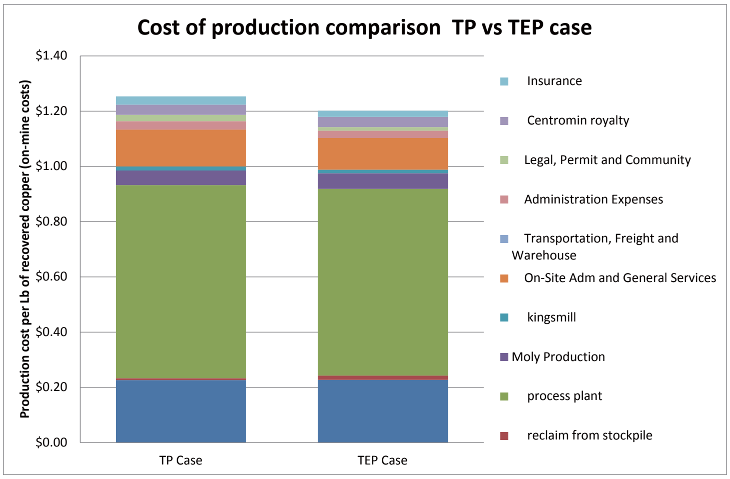


Figure 67: On mine cost of copper production TP option Vs. TEP option

When the cost of finance and the employee profit sharing scheme are considered, the total cost of on-mine production is $1.48/Lb for the TP case and $1.39/Lb for the TEP case. The cost of finance being some 12% of the total on-mine cost of production represents an area where reduction in debt levels could have a marked effect on the total cost of production.

4.8 Process plant modifications to improve recovery

An estimate of possible minor CAPEX costs associated with the process plant modifications is provide below, please note these are purely indicative and only provided as order-of magnitude costs.

For treatment costs within the process plant, it is estimated that the use of NaSH and CMC will add additional reagent costs to the processing but are relatively minor in terms of the expected benefit. The cost of the NaSH is estimated to be some $0.20 per tonne of concentrate, whilst the CMC would be expected to add an additional $0.22 per tonne of concentrate.

In order to allow for the copper recovery improvement programme, it is felt that the allowance of some $0.10/t milled would be appropriate for the duration of the testwork to cover plant surveys around the flotation circuit including assays and simulation work.

Some minor CAPEX items that should be considered are talc-moly storage and a CMC mixing and storage facility, further Arsenic mitigation studies and geometallurgical modelling.

4.8.1 Talc moly storage

This is termed ‘talc sludge’ as described in the Plant Improvement PowerPoint provided from site, the sludge will have to go into a temporary dam as it will contain moly’ which will need to be recovered and treated in the moly’ hydromet plant when operational.

Talc moly’ storage dam – depending on the mass balance and anticipated duration of storage will dictate the size of the dame required. This moly should be captured not sent to tails. Assuming a plastic lined pond to store this for recovery by monitoring and Flyght Pump to the moly’ plant when operational.

An allowance of some $2M for engineering design and construction of a plastic lined pond. It may be possible to use tailings from the tails dam to build the walls and a hypalon liner with recovery system. A subsequent dam could be built based on sizing.

4.8.2 CMC mixing and storage

Capital consideration for the allowance of a CMC Mixing and Storage facility. This is not in the existing flowsheet facilities and would require a mixing and bulk storage tanks with delivery pumps to the flotation circuit. We have assumed a cost of some $2.5 M for engineering design procurement, fabrication and construction.

4.8.3 Studies arsenic mitigation

The arsenic mitigation studies should allow for benchscale testwork and consider both CAPEX and OPEX, it is anticipated that an allowance of $1.5M should be adequate for this purpose.

4.8.4 Geometallurgical modelling

It would be appropriate to consider the long-term benefit of a combined geometallurgical model to ensure a mine-to-mill approach from ore planning through to concentrate delivery. It is estimated that an allowance of $1M would cover the cost of additional metallurgical testwork with a further $1M being appropriate for the creation of a geo-spatial geometallurgical model for mine planning and process forecasting purposes.

4.9 LOM plan cost forecast

An estimation of the likely effects of blending and process modifications to overcome the Talc in ore and ameliorate the Arsenic in concentrate issues has been undertaken by Golder based upon previous experience. It should be noted however, the complexity of the Toromocho ore will mean that actual results can vary and the degree and time taken to achieve improvements could be less or greater than those indicated by Golder. Golder feels that this modified schedule should provide a basis for the medium term planning as an input to a flexed financial model.

In terms of metallurgical recovery, which is a key driver to recovered value from the process plant, Golder has assumed that for 2017 and 2018 an average metallurgical recovery of copper from the ore will be some 90% of planned recovery (e.g. 90% of 85% = 76.5%) with 2019 reverting to design recovery levels of 85%.

During the period when the process plant is carrying out the necessary modifications and establishing blend limits to maximise the metallurgical recovery it is reasonable to expect that the annual throughput will be impacted negatively. To this extent, it has been assumed that the annualised throughput for 2017 will be some 85% of design capacity increasing to 100% of design capacity from 2020 onwards.

Due to the majority of the process plant costs being largely fixed in nature, it has been assumed that although some cost savings on process plant OPEX will probably be realised in 2016, any savings would be temporary in nature and more likely to be cost deferrals than cost reductions. For this reason, the assumed operating expenditure for 2017 to 2019 inclusive has been assumed to be a function of the pro-rated design throughput achieved. The short-term process plant metrics are summarised in Table 40 below.

Table 40: Process plant assumed short-term metrics while recovery issues are rectified

Metric	2017	2018	2019	2020
Mill Throughput (Mt)	36.30	38.50	40.64	42.78
Process Plant OPEX $/t Milled	7.39	6.98	6.61	6.28
Copper metallurgical recovery (%)	76.5	76.5	85.0	85.0

Using the above metrics, although it does not overly change the life of mine financial results, it does change the forecast cashflow status over the short-term and thus should form an important part of any consideration for the five-year plan that typically forms part of the budgeting cycle of mining operations. The build-up of the total cost per Tonne treated is shown in Figure 68, using the identified factors assumed above, the proportion of the process cost can be seen to reduce over the next few years as the process improvements are effected and both design throughput levels and planned ore recovery levels are achieved.

Should ore blending be shown to be a critical aspect in the maximisation of process recovery and mill throughput, it is possible that additional loading capacity will be required within the mining operation, however it is probable that a large front-end loader would provide the mobility to support the existing electric rope-shovels in this regard. In order to ensure sufficient available ore stocks of different types it is may be necessary to include an additional drill to ensure adequate available faces for blending purposes. However these considerations will only be known once an effective process plant treatment and ore feed strategy is established after process modifications.

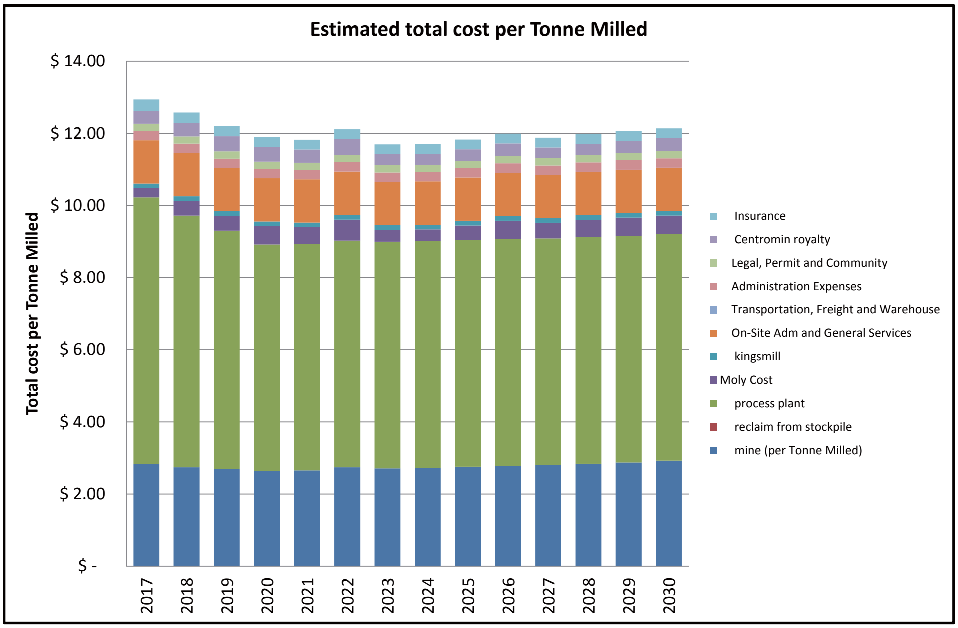


Figure 68: Equivalent cost per mill tonne for Toromocho – without expansion case

The LOM equivalent cost has been considered excluding Finance charges and depreciation, the estimated LOM cost is some $10.98 per tonne milled. If we add to this a further $1.58 per Tonne milled in terms of accounting for Freight and TC/RC costs the operating break-even cost is some $12.56 per tonne milled. This would equate to a break-even cut-of grade of 0.3% Copper equivalent, which as this is notably lower than the planned recovered LOM Copper grade. As such there appears to be no present issues with the planned cut-off grade.

Table 41: LOM equivalent cost per tonne milled

Annual Cost	LOM Average
mine (per Tonne Milled)	$2.08
reclaim from stockpile	$0.06
process plant	$6.07
Moly Cost	$0.45
Kingsmill	$0.13
On-Site Adm and General Services	$1.15
Transportation, Freight and Warehouse	$-
Administration Expenses	$0.26
Legal, Permit and Community	$0.20
Centromin royalty	$0.31
Insurance	$0.26
Total cost/Tonne Milled	$10.98

A summary of the throughput factor and estimated recovery efficiency, driving the cost per tonne processed is shown below in a section of the non-expanded life of mine spreadsheet below in Figure 69.

High-Level Economic analysis of Chinalco Toromocho Copper Project, Peru 15/Aug/2016		Production year +4 2017	Production year +5 2018	Production year +6 2019	Production year +7 2020	Production year +8 2021
		0.85	0.900	0.950	1.000	1.000
Production						
Waste (M tonnes)		24.29	27.20	28.80	19.48	28.32
Low-grade mill material stockpiled (tonnes)		27.88	24.91	23.48	32.78	24.15
High arsenic material stockpiled (tonnes)		1,360,000	506,000	606,000	448,000	37,000
High-grade milling ore (tonnes)		36.36	38.50	40.64	42.78	42.78
total material moved (tonnes)		**89.89**	**91.11**	**93.53**	**95.48**	**95.28**
High-grade ore to mill (tonnes)		36.36	38.50	40.64	42.78	42.78
Low-grade ore to mill (tonnes)		-	-	-	-	-
total ore to mill (tonnes)	1,529,490,810	**36.36**	**38.50**	**40.64**	**42.78**	**42.78**
copper (%)	0.462%	0.606%	0.608%	0.633%	0.601%	0.535%
silver (grams per tonne)	6.13	8.054	6.141	6.767	6.211	6.220
molybdenum (%)	0.019%	0.010%	0.016%	0.016%	0.020%	0.018%
contained metal						
copper (tonnes)	7,062,726	220,349	234,081	257,246	257,096	228,862
molybdenum (tonnes)	285,248	3,636	6,160	6,502	8,556	7,700
silver (grams)	9,375,383,568	292,853,910	236,429,728	275,004,790	265,694,158	266,079,160
metallurgical recovery						
copper (%)	83.8%	76.50%	76.50%	85.00%	85.00%	85.00%
molybdenum (%)	62.1%	65.00%	65.00%	65.00%	65.00%	65.00%
silver (%)	64.2%	65.00%	65.00%	65.00%	65.00%	65.00%
recovered metal						
copper (tonnes)	5,918,945	168,567	179,072	218,659	218,531	194,533
copper (M pounds)	13,049,023,755	371.63	394.79	482.06	481.78	428.87
molybdenum (tonnes)	177,198	2,363	4,004	4,226	5,561	5,005
molybdenum (M pounds)	390,654,615	5.21	8.83	9.32	12.26	11.03
silver (kgrams)	6,020,966,993	190.4	153.7	178.8	172.7	173.0
silver (troy ounces)	193,578,564	6,120,056	4,940,904	5,747,045	5,552,472	5,560,518
UNIT Cost per Tonne Milled						
annual cost	LOM average					
mine (per Tonne Milled)	$ 2.08	$ 2.83	$ 2.74	$ 2.69	$ 2.64	$ 2.66
reclaim from stockpile	$ 0.06	$ -	$ -	$ -	$ -	$ -
process plant	$ 6.07	$ 7.39	$ 6.98	$ 6.61	$ 6.28	$ 6.28
Moly Cost	$ 0.45	$ 0.25	$ 0.41	$ 0.41	$ 0.51	$ 0.46
kingsmill	$ 0.13	$ 0.13	$ 0.13	$ 0.13	$ 0.13	$ 0.13
On-Site Adm and General Services	$ 1.15	$ 1.20	$ 1.20	$ 1.20	$ 1.20	$ 1.20
Transportation, Freight and Warehouse	$ -	$ -	$ -	$ -	$ -	$ -
Administration Expenses	$ 0.26	$ 0.26	$ 0.26	$ 0.26	$ 0.26	$ 0.26
Legal, Permit and Community	$ 0.20	$ 0.20	$ 0.20	$ 0.20	$ 0.20	$ 0.20
Centromin royalty	$ 0.31	$ 0.36	$ 0.37	$ 0.42	$ 0.41	$ 0.37
Insurance	$ 0.26	$ 0.32	$ 0.30	$ 0.28	$ 0.27	$ 0.27
Total cost / Tonne Milled	$ 10.98	$ 12.94	$ 12.58	$ 12.20	$ 11.89	$ 11.82
total cash cost						
financial cost	$ 1.88	$ 4.49	$ 4.42	$ 4.24	$ 3.81	$ 3.61
depreciation	$ 3.76	$ 7.44	$ 7.62	$ 6.66	$ 4.43	$ 4.33
employee profit sharing	$ 0.19	$ -	$ -	$ 0.12	$ 0.30	$ 0.14
net income before taxes						
Total cost per Tonne Milled equivalent	$ 16.81	$ 24.87	$ 24.62	$ 23.21	$ 20.43	$ 19.90

High-Level Economic analysis of Chinalco Toromocho Copper Project, Peru 15/Aug/2016	Production year +9 2022	Production year +10 2023	Production year +11 2024	Production year +12 2025	Production year +13 2026
	1.000	1.000	1.000	1.000	1.000
Production					
Waste (M tonnes)	25.61	42.30	52.09	52.30	52.32
Low-grade mill material stockpiled (tonnes)	27.18	9.85			-
High arsenic material stockpiled (tonnes)	1,839,000	480,000	21,000	0	0
High-grade milling ore (tonnes)	42.78	42.78	42.78	42.78	42.78
total material moved (tonnes)	**97.41**	**95.41**	**94.89**	**95.07**	**95.09**
High-grade ore to mill (tonnes)	42.78	42.78	42.78	42.78	42.78
Low-grade ore to mill (tonnes)	-	-	-	-	-
total ore to mill (tonnes)	**42.78**	**42.78**	**42.78**	**42.78**	**42.78**
copper (%)	0.653%	0.462%	0.452%	0.468%	0.503%
silver (grams per tonne)	5.456	5.294	4.618	5.343	6.009
molybdenum (%)	0.023%	0.013%	0.013%	0.016%	0.020%
contained metal					
copper (tonnes)	279,340	197,634	193,357	200,201	215,173
molybdenum (tonnes)	9,839	5,561	5,561	6,844	8,556
silver (grams)	233,396,768	226,466,732	197,548,804	228,562,854	257,053,002
metallurgical recovery					
copper (%)	85.00%	85.00%	85.00%	85.00%	85.00%
molybdenum (%)	65.00%	65.00%	65.00%	65.00%	65.00%
silver (%)	65.00%	65.00%	65.00%	65.00%	65.00%
recovered metal					
copper (tonnes)	237,439	167,989	164,353	170,171	182,897
copper (M pounds)	523.46	370.35	362.34	375.16	403.22
molybdenum (tonnes)	6,395	3,615	3,615	4,449	5,561
molybdenum (M pounds)	14.10	7.97	7.97	9.81	12.26
silver (kgrams)	151.7	147.2	128.4	148.6	167.1
silver (troy ounces)	4,877,522	4,732,698	4,128,372	4,776,503	5,371,889
UNIT Cost per Tonne Milled					
annual cost					
mine (per Tonne Milled)	$ 2.74	$ 2.71	$ 2.73	$ 2.76	$ 2.79
reclaim from stockpile	$ -	$ -	$ -	$ -	$ -
process plant	$ 6.28	$ 6.28	$ 6.28	$ 6.28	$ 6.28
Moly Cost	$ 0.58	$ 0.33	$ 0.33	$ 0.41	$ 0.51
kingsmill	$ 0.13	$ 0.13	$ 0.13	$ 0.13	$ 0.13
On-Site Adm and General Services	$ 1.20	$ 1.20	$ 1.20	$ 1.20	$ 1.20
Transportation, Freight and Warehouse	$ -	$ -	$ -	$ -	$ -
Administration Expenses	$ 0.26	$ 0.26	$ 0.26	$ 0.26	$ 0.26
Legal, Permit and Community	$ 0.20	$ 0.20	$ 0.20	$ 0.20	$ 0.20
Centromin royalty	$ 0.44	$ 0.31	$ 0.30	$ 0.32	$ 0.35
Insurance	$ 0.27	$ 0.27	$ 0.27	$ 0.27	$ 0.27
Total cost / Tonne Milled	$ 12.11	$ 11.69	$ 11.70	$ 11.83	$ 11.99
total cash cost					
financial cost	$ 3.46	$ 3.22	$ 3.26	$ 3.20	$ 3.17
depreciation	$ 4.33	$ 4.33	$ 4.26	$ 4.24	$ 4.24
employee profit sharing	$ 0.48	$ -	$ -	$ -	$ 0.11
net income before taxes					
Total cost per Tonne Milled equivalent	$ 20.38	$ 19.24	$ 19.21	$ 19.27	$ 19.51

Figure 69: Toromocho non-expanded case with process plant build up over period 2016 to 2020

4.10 Review of Behre Dolbear ITR 2012

In November 2012, Behre Dolbear Asia carried out an update of ITS April 2012 Independent Technical Review ITR). The November 2012 update primarily focussed on social, permitting and environmental issues as the April 2012 ITR had covered in detail technical aspects related to the project.

Items that remain outstanding at July 2016 include the following:-

"4.11.3.6 Town of Morococha Resettlement" the majority of resettlement has occurred with a relatively small number of residents remaining behind in the old town of Morococha. This continues to be an issue that is currently being managed at mine level.

Golder concludes that the overall risk to the project value is still considered to be low; however it is believed that lobbying further support from government would assist in demonstrating government's commitment to investment in the country.

The November 2012 ITR concluded with:-

"*4.11.3.12 Social Summary – three discrete social risk issues are identified by the Behre Dolbear team.*

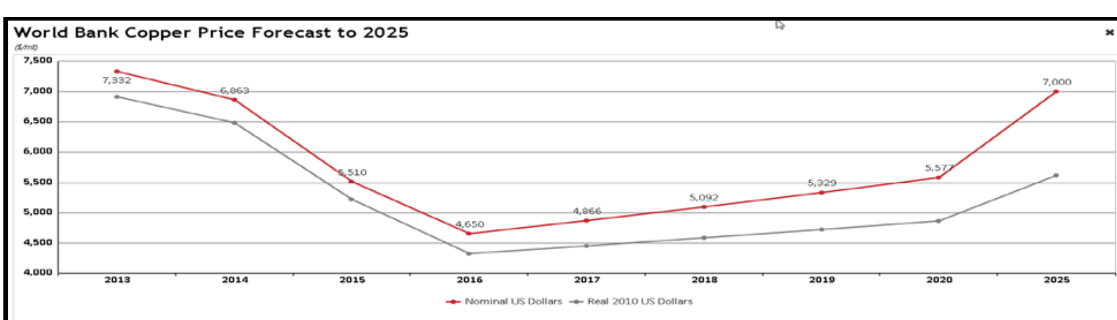
- *Ongoing negotiation processes through the round table process are likely to result in an agreement whereby the Company will provide funding for additional development initiatives. The likely costs will amount to a Low Risk/Likely to occur either within the CAPEX or early operations period.*
- *Resettlement incorporates Low Risks/Likely to result in cost escalation related to contingency plans for resettlement of new arrivals and compensation for new structures.*
- *Transportation safety risks remain a Moderate Risk/Possible to occur while personnel and goods are still transported by road.*"

Golder notes that the transportation risk concern has been addressed through the provision of dedicated coaches that transport the shift workers from site to Lima at the commencement and completion of their shift Roster periods. There is evidence that the roads are being improved (2016) with road repairs occurring in several places between Lima and the Toromocho project site.

Financial risk

The April 2012 ITR had reviewed long-term forecast metal prices for copper, silver and molybdenum. Since some 80% of the project value will be derived from copper sales focus has been given to the historical (2012) forecast prices and the current (2016) forecast prices.

The latest forecast from the World Bank (Figure 70) continues to show the copper price as being above $5500/t but with a slower recovery than previous estimates.

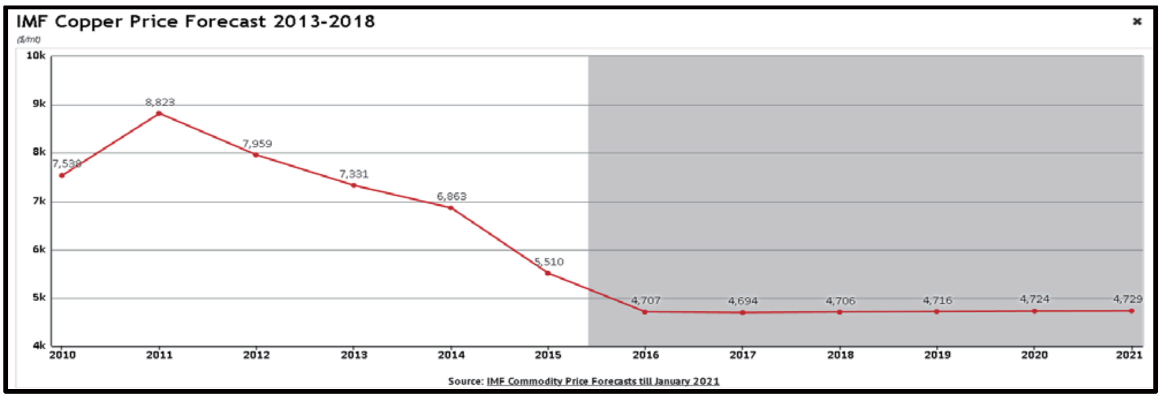


Source: knoema.com

Figure 70: World Bank Copper Forecast 2016

The IMF forecast remains somewhat softer than the World Bank Forecast and shows a LT forecast for Copper as being around the $4700 per Tonne (Figure 71) with only minor growth from 2017. These forecasts differ markedly from the forecasts in 2012 wherein all banks had forecast a LT copper price in $5 500 to $6 500 range.

A continued low copper price, which is some 80% of the Toromocho Project income stream, renders early repayment of project capital as being unlikely.



Source: knoema.com

Figure 71: IMF copper forecast 2016

A similar forecast trend is seen for silver, with both the World Bank and IMF now forecasting silver prices at some 20 to 30% below the 2012 consensus price.

Given the current softer outlook in metal pricing for the period to 2020, it would appear prudent to focus on maximising value related to the current project ahead of any commitment for the expanded option. The two principal drives to value maximisation currently are the metallurgical recovery and financial penalties being imposed as a result of the arsenic levels within the copper concentrate.

The Toromocho Project would appear unlikely to provide a satisfactory level of financial return currently without improvements in both the metallurgical recovery and reduction of arsenic levels in concentrate.

Behre Dolbear in their ITR report "*The Toromocho ITR Update, as of date of September 30, 2012, reconfirms the economic viability of the Toromocho Project as projected in the April 2012 Toromocho Project ITR. However, Behre Dolbear, again, cautions that the mining industry is cyclical and when a new cycle of lower prices will occur is not known.*"

In terms of the cyclical nature of the copper market, the following extract is taken from mining.com dated April 2015 (Christine Meilton, principal consultant on copper supply at commodities researcher CRU Group) – "*Our short term forecast is the price rising through the decade. Prices have typically been above the cost curve in the past although the price this year is biting into the cost curve," says Meilton*

An emerging tightness in 2017, driven by deficits in the raw materials markets, will support a higher price in 2017. Thereafter the price will continue to improve due to the deficit market, moving above $8,000 a tonne ($3.60 a pound) in 2019 says Meilton.

"Copper mining is getting more difficult. The best deposits have been discovered and exploited. As a rule grades are higher at current operations than at projects, which means costs are higher. There is no Escondida out there, at least it hasn't been found yet," says Meilton adding that the long-term incentive price for new projects is now north of $3 a pound and that prices oscillates around the long term marginal cost."

Forecasting copper prices has traditionally been difficult with many analysts focussing on the relatively short- term supply side. Toromocho is a deposit with an expected mine life of almost 40 years and as such can be expected to go through several price cycles in its operating life-span. The main financial concern is the relatively long-lead time to payback at present metal prices, however copper prices are presently considered low with project expansions globally being questioned or deferred.

In terms of immediate priority, focus is quite correctly being applied to maximising the potential metallurgical recovery through the process plant. The maximisation of copper recovery is presently being seen as being a key component to achieving the lowest unit cost of production. The reduction in arsenic levels in concentrate is a secondary issue that will continue to receive on-going focus.

4.11 Tailings

The Behre Dolbear did express reservations about the deposition method being proposed for the tailings in that the Behre Dolbear report stated:

"The chosen tailings deposition system is being designed by Golder & Associates. The system envisions the production of 55% solids tailings at the concentrator for transport to five "new generation" paste thickeners at the tailings impoundment. The installation of units with an unsubstantiated operating record must be regarded as high risk. On a short- term basis, the tailings impoundments can take normal tailings (50% to 60% solids) into the maintenance dump area. Over the long term, deposition of normal tailings would result in running out of tailings deposition room — **Moderate to High Risk/Low to Possible."**

Paste thickened tailings are now an accepted method of deposition, and whilst this may have appeared as new unproven technology at the time, this would no longer apply. The tailings dam being constructed at the mine site was inspected during the site visit and the construction method and civil engineering quality of the dam appears impressive (Figure 72). It is also worth noting that the position of the tailings dam impoundment wall would not appear to preclude a future downstream raise for an additional dam at some point in the future if further mineable resources become available or the final density of the tailings (solids fraction) is not entirely realised.

Figure 72: Tailings dam wall construction – July 2016

5.0 METALLURGY

5.1 Historical Toromocho Project

From 1970 to 1985 Cerro de Pasco and Centromin undertook metallurgical testwork on the Toromocho ore. The ores were mined underground and treated over many years previously.

Various other groups undertook studies and work until Aker Kvaerner undertook a Feasibility Study in 2006. Three ore composites were tested and grind recovery relationships developed. The Feasibility Study testwork does say the talc is a possible concern and will have an impact on copper concentrate grade. This was to be managed by blending. The reality is there is so much talc in the ore body it may not possible to blend it out satisfactorily. There appears to have been greater emphasis on molybdenum recovery than on potential issues related to the talc in ore. No mention of arsenic issues other than blending.

There was a Concentrate Leach Study and a molybdenum Hydrometallurgical Plant Study but these options did not proceed to final flowsheet. The proposed moly plant is currently under construction.

A Scoping Study in 2006 looked at a Heap Leach project. The heap leaching gave very poor copper recovery on the sulphide ore. Heap Leaching was evaluated and tested for the high talc and high arsenic ore but recoveries were also poor.

Whilst at first it sounds like a simple solution this is far from the truth. Firstly heap leaches have a 50% success rate and sometimes the learning curve can be years. Before launching into this they would need to do extensive testwork and a Study at Feasibility level.

The initial testwork gave variable results and focussed on acid and cyanide soluble copper. Chalcopyrite normally passivates in a heap and bacterial activity is critical. Digenite, covellite, bornite tennantite and enargite are more leachable.

More often than not the ore has to be crushed to say 12 mm or finer and agglomeration is required (extra cost) for effective percolation. The talc could cause percolation issues because it is a clay. The column leaches on 25 mm ore samples over an average of 286 days gave 54 to 75% copper recovery. Acid consumption was low.

In addition an SX/EW plant is required, which significantly increases the CAPEX. The cash flow from heap leaching is an issue because it is much slower than a concentrator. If a larger part of the ore was diverted to heap leaching the project economics would change significantly. With a heap leach a flowsheet for handling the arsenic would be required and the long term storage. The significant water requirement for heap leaching also needs to be considered.

The concentrator is established and provides certainty of copper recovery compared to a heap leach, which can be improved further. For this reason Golder believes it is lower risk and better economics to focus on treating the concentrate than to go heap leaching.

The Aka Kvaerner Feasibility Study opted for a simple primary crush SAG/ball grind followed by flotation and sale of a concentrate. This is the current flowsheet utilised and the scale of the project is very large based on processing 117 200 tonnes of ore a day. A Feasibility Study does not guarantee success and the deviations from the Feasibility Study suggest there could be a lot of technical work required to improve the current metallurgical performance

5.2 Current Toromocho Project

The flowsheet for processing the Toromocho ore is very conventional and appropriate for a copper sulphide ore. The orebody is however complex by domain and ore types and it appears that the significance of this was not fully recognised in developing the flowsheet that was adopted. Blending was proposed as a solution to iron out fluctuations and other contaminants in the concentrate. If the arsenic and talc issues had been more readily understood it is probable a different flowsheet would have resulted.

The Feasibility study was exhaustive but failed to identify three serious deficiency issues with the process metallurgy. The geometallurgy appears to have been too superficial for the scale of the project and the consequential loss resulting from deviations from design (Table 42) is now very significant.

The first serious issue not identified in the Feasibility Study is the copper recovery is only 70% compared to a predicted recovery of 80% to 87% in the Feasibility Study. This is being addressed on site using Mr Tom Olsen who was also involved in the Feasibility Study and is now working on the plant improvement initiative project.

The second serious issue overlooked is the presence of significant amounts of talc minerals (insol) in the ore that are naturally floatable. This leads to lower concentrate grades and attempts to remove the talc result in lower recovery. The talc also adsorbs flotation reagents and results in copper flotation losses. Smelters have limits on the amount of talc in concentrate because it produces viscous slags and difficulties for the smelter. It also incurs higher transport costs.

It is understood Toromocho are buying clean copper concentrates to blend with theirs to reduce the insol and arsenic in the concentrate at an increased cost to the project.

The third serious issue not identified in the Feasibility Study is the high arsenic reporting to concentrate. Arsenic is a penalty element for smelters and at levels exceeding 0.3% the smelters may reject the concentrate. Arsenic is environmentally a problem for copper smelters and penalties apply when it is high. The actual levels of arsenic in concentrate appear to be somewhat higher than had been anticipated. The arsenic problem is likely to persist throughout the ore so a solution needs to be developed for the longer term.

Table 42: Basic plant design criteria

Basic Design	
Ore Grade	0.612% copper
Ore Grade	0.019% moly
Copper Recovery	87%
Copper Concentrate Grade	26.5%
Moly Recovery	65.0%

5.3 Mineralogy

The deposit is a porphyry intrusive and skarns. It consists of hornfels, potassic, serpentine magnetite, serpentine talc, actinolite-tremolite and fillic rocks.

The presence of arsenic is not mentioned apart from one document in the PFS. It does mention talc but not of any significance and suggests blending will manage the talc problem. This comment over simplifies the issue because there is insufficient low talc ore to blend. The only commented noted was that insol in the concentrate could attract penalties.

The ore flowsheet was piloted at Lakefield Research and no issues arose or concerns raised. This raises serious questions as to the representivity of the ore sample tested during piloting and the understanding of the orebody.

5.4 Behre Dolbear due diligence

The Behre Dolbear (BD) Report Competent Persons Report did not predict a lower copper recovery or discover the arsenic and talc issue or raise it as a significant risk. They signed off on the metallurgy as described in the Feasibility Study Report.

BD did express concern about the lack of locked cycle tests and this is a valid concern because it does not truly reflect likely plant performance. BD believed the sampling was done at a high level and provided confidence in the predicted results. This has not borne out to date and appears to be an incorrect conclusion when viewed by the current plant performance.

BD appear to have been influenced by the previous small underground operations; good piloting results, and seem to have missed the significance of the arsenic and the talc issue leading to lower copper recovery. BD appear to have been optimistic in their predictions of copper recovery. The arsenic was noted in the Pre-feasibility Study but appears to have been largely overlooked in the Feasibility Study along with the impact of the talc.

It appears that insufficient representative metallurgical testing had been undertaken covering the various types of ore and spatial extent of the ore.

This highlights the increased risks encountered when the project scale increases based on a large scale open pit and the sampling and representivity does not match the scale of the project.

5.5 Talc flotation issues

Talc is naturally hydrophobic and floatable with water and frother. It is a serious and difficult problem to manage mainly with sulphide ore flotation such as nickel and copper. It contains no copper minerals and is a diluent in copper concentrates. The difficulty of solving this problem should not be under estimated given that the Toromocho ore has significant talc throughout most of the ore zones. The levels of talc in some ore zones are high (1-2% would be considered low).

Talc is a clay mineral composed of hydrated magnesium silicate with the chemical formula $Mg_3(SiO_3)_4$. It occurs as foliated to fibrous masses, and in an exceptionally rare crystal form. It has a perfect basal cleavage, and the folia are non-elastic, although slightly flexible. It is the softest known mineral and listed as 1 on the Mohs hardness scale. As such, it forms slimes in the grinding process. It has a specific gravity of 2.5 to 2.8, a clear or dusty lustre, and is translucent to opaque. Talc is not soluble in water, but is slightly soluble in dilute mineral acids.

In flotation circuits talc slimes and adsorbs flotation reagents starving the copper minerals of collector and readily floats to the concentrate reducing the quality of the concentrate.

5.5.1 Acid leaching of talc from concentrate

Talc is very resistant to acid attachment by leaching using hydrochloric, sulphuric or nitric acid. The copper minerals will leach, making this ineffective where a concentrate is required. The talc cannot be leached out so this is not an option.

5.5.2 Spiral treatment

We are aware of one operation that has used spirals on a porphyry copper concentrate to reject clean talc (sg difference copper and talc). No data is available on the effectiveness of this. It is something that could be tested in a commercial laboratory and would be a low operating cost solution.

5.5.3 Talc pre-float

The ore is first ground preferably under substantially non-reducing conditions and then the ground ore is subjected to a talc pre-float wherein the fast floating talc can be recovered in a preliminary stage of flotation without an excessive loss of copper. This is done simply using frother and no collector. This talc concentrate may be further cleaned and discarded to tailings. Where large amounts of talc are present this can often be the best and only effective solution.

The sulphide-containing tailing from the talc pre-float is then subject to split conditioning followed by flotation in the presence of xanthates to selectively float copper minerals.

This would need to be tested in the laboratory and require retrofitting large flotation columns in the plant ahead of the copper flotation.

5.5.4 Talc depression

The common talc depressant is Guar or Carboxy Methyl Cellulose (CMC). Where there is a lot of talc present this can be very costly in reagent use and result in depressing copper minerals if overdosed. Polyacrolates and modified lignin sulphonate are also used depending on the talc mineralogy. From an operating perspective, the use of talc depressants is difficult to manage. Some nickel ores cannot be treated because of high talc levels (South Windarra, WA).

It is best to screen a number of depressants in the laboratory and select the best depressants for plant evaluation. The cost can be high (CMC) so the cost benefit needs to be evaluated and sometimes determines that Guar is preferred because of its lower cost.

The talc levels appear to be too high for this to work effectively however laboratory testwork will confirm this conclusion.

5.5.5 Talc deslime ahead of flotation

This is used at BHP, Nickel West at Mt Keith in Western Australia where the nickel ore contains significant talc levels. They use large banks of 50 mm polyurethane cyclones to deslime the talc from cyclone overflow ahead of the flotation feed. The cyclones cut at 2 µm, resulting in very little nickel being lost. The removal of the talc to tailings results in a higher nickel recovery and lower reagent costs and a higher concentrate grade. Attrition scrubbing ahead of the deslime may also help with talc removal in these situations.

This could be tested in the laboratory to determine the optimum cut size for discard of barren talc.

5.5.6 Talc dispersants

Sodium silicate and phosphate dispersants can improve selectivity and reduce the entrainment of talc in the concentrate. These should be evaluated in the laboratory first. Reduced pulp density will result in more talc floating and can be validated in the laboratory to establish the optimum density.

This could be tested in the laboratory at a range of dose rates.

5.6 Arsenic in concentrate – mitigation options

5.6.1 General

The final copper concentrate contains significant arsenic and is currently incurring smelter penalties. Copper arsenide minerals, such as enargite (Cu_3AsS_4), can be processed by pyrometallurgical techniques, e.g. roasting or by smelting. Such processes, however, may not be sustainable in the long run due to the decreasing market for the resulting arsenic trioxide dust and environmental and occupational health (OH&S) issues associated with arsenic oxides. Hydrometallurgical processes are now the preferred option being proposed to treat arsenical copper sulphide feeds as a solution to the problem of arsenic in concentrates.

The High Temperature Pressure Oxidation Process (POX) or low temperature atmospheric leaching which, in addition to extracting some copper, fixes the arsenic as scorodite (iron arsenate) or ($FeAsO_4.2H_2O$), an arsenic product that is stable, according to regulators and the standard arsenic leachate test.

5.6.2 Continue paying penalties

The do nothing approach, will result in ongoing penalties being charged for the arsenic in the concentrate. There is a significant ongoing cost to the project for this. Arsenic has closed smelters in Europe and the USA and smelters prefer low arsenic concentrates. This situation is likely to get worse over time.

Based on the mine schedule and arsenic assays this needs further investigation to predict future outcomes.

5.6.3 Blending of clean concentrates

This is being undertaken but is a very costly solution for Toromocho. This is not a long term solution.

5.6.4 Separate arsenic concentrate

It would be possible to treat the final concentrate with a chemical oxidant in conditioning tanks and re-float a relatively clean concentrate. The arsenic copper minerals will be tarnished and not float. The effectiveness would be subject to laboratory testing and the conditions would be at a precise REDOX and for a determined time. Golder has undertaken such specific testwork in the past and can assist in developing this at bench-scale. The mass split is not known although we believe >90% of the arsenic can be recovered in a mixed copper concentrate.

The high arsenic concentrate resulting from this process would have to be processed separately on site. Options for this processing are discussed hereafter.

5.6.5 Selective pre-roast

This process could be undertaken on site. It was developed by St Joe Minerals for their El Indio enargite concentrate. During this process, most of the arsenic and the labile sulphur were volatilised and oxidised in the gas chamber to arsenic trioxide and sulphur dioxide. Arsenic trioxide was condensed and sold as pure compound (≥95% As). The partially roasted copper concentrate, assaying +33% Cu or better, with <0.04% As was a more marketable copper concentrate.

The arsenic section of the plant has increased OH&S issues because of the arsenic. Arsenic as a sulphide is benign but as an oxide, it is highly toxic to all mammals, birds, and fish.

5.6.6 Non-oxidising selective leach process

This process uses autoclaves at 180-220°C to remove some iron and arsenic plus other impurities. The iron passes into solution accompanied by other impurities such as cobalt, nickel, zinc, lead, bismuth, thorium and its daughter products, and uranium and its daughter products. The process can be carried out in sulphate or sulphate-chloride media. Very clean premium copper concentrates are produced.

OZ Minerals in Australia is conducting a PFS for this type of facility as part of its Carrapateena project in South Australia with a view to establishing a commercial operation. Successful pilot and demonstration plant campaigns and smelter trial tests have been carried out. Incentives include significant freight savings, long term protection from penalties and competitive market advantage. No existing commercial operating plants exist for this process.

5.6.7 Alkaline selective leach process

This alkaline leach process for the removal of arsenic, antimony and other penalty elements from copper concentrates. This is based on the Sunshine Mining Process, which was historically used commercially over a long period. Sodium carbonate and sodium hypochlorite have also been used for arsenic removal particularly enargite from copper concentrates.

The flowsheet consists of an atmospheric tank caustic leach followed by filtration and washing of the cleaned concentrate. The filtrate is treated in a pressure oxidation autoclave and any gold and antimony is precipitated, after which arsenic is precipitated from the solution in a stable disposable form. The final solution is concentrated by evaporation and recycled to leach. The chemistry follows.

$$2\ Cu_3AsS_4 + 3\ Na_2S \rightarrow 2\ Na_3AsS_4 + 3Cu_2S$$

5.6.8 Atmospheric oxidation process

Acidic oxidation of enargite occurs in an acidic environment based on the following chemical equations. This can be carried out under atmospheric conditions at elevated temperatures.

There are no patents and this has been used commercially. The trick is not to oxidise too much copper. Residence times can be between 10 to 24 hrs depending on grind size and mineralogy. The chemistry follows.

$$4\ Cu_3AsS_4 + 3O_2 \rightarrow 12\ CuS + 2\ As_2O_3 + 4S$$

$$CuS + 2O_2 \rightarrow CuSO_4,\ \text{plus}\ S + O_2 \rightarrow SO_2$$

5.6.9 Bacterial process

These have been mostly unsuccessful and not worth considering for arsenic removal.

5.6.10 Ferric sulphate leach process

The Rapid Oxidative Leach (ROL) Process is being developed by FLSmidth in USA. It utilises a series of stirred media reactors (SMRt) in tandem with conventional agitated leach tanks with ferric sulphate lixiviant and oxygen sparging at 80°C. Copper recovery of 97-99% is achieved in about six hours for chalcopyrite concentrates and 12 hours for enargite. It was announced in February 2016 that a pilot plant facility is being built onsite at FLSmidth's Minerals division headquarters located in Salt Lake City. Also, they have signed a joint R&D agreement with BASF to expedite commercialisation. BASF will focus on innovative SX extractants with high degradation resistance and increased copper selectivity.

No commercial operating plants exist for this process.

5.6.11 Glycine leach process

The GlyLeach™ Process, under development at Curtin University, Australia, is an alkaline-based process utilising glycine, a non-toxic, non-corrosive, environmentally benign amino acid for leaching copper, gold, and silver from primary copper sulphide concentrates as well as secondary sulphide, mixed and oxide ores. The flowsheet typically includes ultrafine grinding, pre-oxidation with oxygen, atmospheric tank leaching at <100°C, and solid liquid separation. Copper is recovered from the solution by SX/EW (or sulphide precipitation), followed by pH adjustment and precipitation of silicates/carbonates with lime, then gold recovery in carbon columns before recycling to leach.

No commercial operating plants exist for this process.

5.6.12 Ferric chloride leaching

Enargite (Cu_3AsS_4) can be leached in acidic ferric chloride solution. The ferric chloride can be hydrolysed to precipitate stable arsenic and iron oxide. The regenerated ferric chloride can be recycled. This also requires an oxygen plant. There is reference to past operating plants.

No commercial operating plants currently exist for this process.

5.6.13 On-site copper concentrate processing options

One option is to accept the arsenic levels and high talc levels and process the whole or part of the copper concentrate on site. There are many process options and these are all high CAPEX options but will produce value added copper.

Where a stable iron arsenate is produced this can go to tailings however there are environmental considerations. Where arsenic gasses are involved this can prove environmentally difficult.

Golder has extensive files on all of these processes and technical information far in excess of this report. We have also visited and undertaken laboratory testwork on similar concentrates. We have endeavoured to present the options at a high level for ease of consideration.

5.6.14 Total pressure oxidation (POX)

Total pressure oxidation is the process used for processing of chalcocite at the Mt Gordon mine site. The process utilises low temperature and low pressure autoclaves in order to oxidise sulphides to enable copper extraction. The operating temperature is around 90°C and copper oxidation is as high as 99%. The process is a simple design and uses mild operating conditions. Although this process was designed solely for the Esperanza ore.

For comparative purposes, this process was included for short listing. There are many commercial operating POX plants around the world including specific copper plants at Bagdad Copper in Arizona. The Sherrit Gordon type POX plants are very common on nickel, copper, zinc and pyrite gold concentrates. References can be provided if necessary regarding these operating plants.

5.6.15 Intec

The Intec process is a chloride leach incorporating fine grinding of copper concentrate but to date there are no commercial examples of the Intec process in operation. However, as the technology appears suitable to a Toromocho concentrate, this process was included for short listing for comparative purposes. No operating plants exist but a pilot plant is available for testing concentrates.

5.6.16 Activox

The Activox process is a pressure oxidation process using an autoclave and incorporates fine grinding of the copper concentrate. Mild operating pressures and temperatures can be used due to the greater liberation of copper minerals from fine grinding. However, there are no commercial examples of the Activox process in operation. The one operation in Botswana was a commercial failure. The technology is licensed by Norilsk.

As the technology appears suitable to a Toromocho concentrate, this process was included for short listing for comparative purposes. Licencing conditions are uncertain.

5.6.17 BioCOP

The BioCOP process is a tank bacterial leaching process developed by BHP Billiton at their Escondida operation.

As it is an in-house development, information is very difficult to obtain and therefore little technical and financial information is available on the process.

This option has therefore been eliminated from further consideration.

5.6.18 BacTech

The BacTech process is a tank bacterial leaching process developed by BacTech and its partner Mintek. BacTech/Mintek has run pilot scale campaigns and commercial opportunities are being actively pursued. Furthermore, commissioning of a 0.5 t concentrate/day demonstration plant is currently being completed at Industrias Penoles research facility in Monterrey, Mexico. The relatively straightforward process and the lower capital and operating costs, has made it an appealing process.

Bacterial leaching works well in the laboratory but has a bad name with respect to commercial operating plants. This should not be considered.

5.6.19 Escondida ammonia leach

This process was developed by BHP and employs air combined with a solution of ammonia and ammonium sulphate to leach cuprous salts from chalcocite solutions. Approximately half the copper is leached and the remainder can be recovered by a flotation recycle. Information is limited on the Escondida process; therefore it has been decided not to consider the process any further. In addition, several attempts were made to contact the Escondida mine, as well as BHP's base metal department. No responses were received, hence the lack of information available to consider the process further. Furthermore, the process does appear to be unattractive due to the ammonia used in the leaching process and the unnecessary complexity of the process.

This option is not considered suitable for the Toromocho operation.

5.6.20 Nitrogen species catalysed

This process is based on moderate pressure oxidation at 125-155°C, catalysed with nitrogen species supplied from sodium nitrite. The process has been operated successfully on an industrial scale (Sunshine Mining and Refining in Montana), but closed down due to depleted silver resources. The process is particularly attractive for chalcopyrite ores bearing a high silver content. However, there are no other plants in operation.

It was decided that the process is not suitable for Toromocho concentrate and was not considered for short listing.

5.6.21 Hydrocopper

The HydroCopper process developed by Outokumpu operates in a chloride environment allowing economical copper metal production. Numerous attempts were made to contact Outokumpu with regards to their Hydrocopper technology, but no responses were received. In addition, the process appeared to be designed for chalcopyrite primary ores, which meant the process appeared overly complex for what was required with the Toromocho ore. The high chloride environment would be difficult with respect to materials of construction.

For these reasons, the Hydrocopper process was not short listed for treating a Toromocho concentrate.

5.6.22 CESL

Cominco Engineering Services Ltd. (CESL) has developed the CESL copper process that is capable of treating various sulphide minerals and has been tested successfully on all the well-known minerals already, including chalcopyrite. The process can be developed to handle low and high grade concentrates. The Toromocho concentrate appeared to be a good technical fit for the CESL process, but there are no operating plants worldwide.

However, the process will not be short listed for further consideration.

5.6.23 Roast leach electrowin (RLE)

This is old and established conventional technology.

- Low technical process; fine grinding not required
- Leaching is operated at ambient conditions
- Licence fees required for electrowinning
- Used in some Zambian operations

This process was short-listed for final ranking as it is commercially proven. A sulphuric acid by-product would also be produced. The environmental issues with arsenic would be significant.

5.6.24 Albion process

- Lack of commercial plant which will require additional testwork and engineering due to scale up issues
- Highly dependent on mineralogy

This process was not short-listed for final ranking. There are two operating plants on small projects.

5.6.25 Ausmelt/Isasmelt

- Commercially established in about 20 smelters
- Tsumeb smelter in Namibia is an Ausmelt furnace

- Ausmelt claim that a 4.4 m diameter furnace can process 1 Mtpa copper concentrate. The Tsumeb smelter internal diameter is 4.4 m
- Environmentally friendly >98% sulphur capture
- Rule of thumb economic feasibility of smelter is >150 000 tpa copper, although they do have a high turndown ratio and 40 000 tpa copper probably is economical for say the high arsenic fraction of concentrate. The environmental issues with arsenic would be significant.
- A clean high grade matte could also be produced.

This process was short-listed for final ranking

5.6.26 Outokumpu flash smelting

- Commercially established – 40% of world copper produced by flash smelting
- Different smelting technology to Ausmelt – feed preparation requires drying
- Rule of thumb economic feasibility of smelter is 150 000 tpa copper. These are large tonnage smelters. The environmental issues with arsenic would be significant.
- An acid by-product would be saleable.

This process was not short-listed for final ranking as the CAPEX would be too large.

5.6.27 Copper sulphate production from copper concentrate

If a high arsenic fraction of the concentrate was processed copper sulphate could be produced suitable for the fertiliser market.

- Copper sulphate pentahydrate can be sold at a price/tonne, which is approximately one fifth of the LME copper cathode price. This equates to the 20% copper in the product.
- This is a market driven process and needs this in place prior to any financial commitment.

This process was not short-listed for final ranking.

5.6.28 Concentrate sales for life of project

- Expensive transport costs.
- Issues with transport infrastructure/reliability.
- High arsenic concentrates attract penalties.
- High arsenic concentrates may not be saleable in the future because of environmental issues.

This is the Base Case for comparison.

5.6.29 BRISA

The BRISA process is being developed by a Spanish research institute and currently still at laboratory scale. There is no large-scale test work or industrial application available on this technology. The applicability of BRISA process for treating Toromocho concentrate cannot be verified. Therefore, the process cannot be considered further.

There are no commercial operating plants.

5.6.30 Cymet

The Cymet process involves high temperature process operations, which would increase the complexity of the process probably resulting in elevated capital and operating costs. Therefore, the Cymet process will not be further considered for the treatment of Toromocho concentrate.

5.6.31 Dextec

The Dextec process was a patented process from the late 1970s. The process is a typical chloride leach and thickening operation similar to the Cymet process. There is no large-scale plant or industrial application available for the Dextec process and it has not been seen in the technology market since a legal campaign with a European company. Therefore, due to the discontinued development of the process, the Dextec process will not be considered further for the processing of Toromocho concentrate.

5.6.32 GEOCOAT

GEOCOAT is a heap leach technology whereby copper concentrate is sprayed onto host rock material and subjected to bio-oxidation. The process is simple and not expensive, thus is an important process to be looked at as an approach to oxidise the Toromocho copper concentrate or high arsenic concentrates.

However, as the technology appears suitable to a Toromocho concentrate, this process was included for short listing for comparative purposes. It may be very applicable for the high arsenic concentrate but would require SX/EW facilities as well. Usually bacterial enhancement is also used for the process. Bench-scale testwork could be undertaken at laboratory scale to rule this in or out.

5.7 Plant improvement initiatives

The information in this section is summarised from PROCESS PRESENTATION AUDIT JULY 2016.pptx.

These initiatives currently being undertaken on site will mitigate the impact of the talc and lower recovery. They will not address the arsenic issue and whilst not high CAPEX they are only a relatively partial short-term solutions.

5.7.1 Copper recovery

This has to be the highest priority item. Essentially these technical innovations and improvements will be low CAPEX but provide an immediate improvement in copper recovery and grade.

5.7.2 Blending

This will iron out the extremes but a shovel change or equipment failure can introduce a significant ore change. The arsenic and talc are throughout the orebody so this will have limited effectiveness.

5.7.3 Grinding improvements

Changes to the ore feed coupled with the primary crusher and changes to the SAG mill will be aimed at improving the grind. In addition, the ball size will be reduced to improve grinding efficiency.

5.7.4 Reagent optimisation

The reagent dosing is not on a ratio control and more dosing points will be added to improve collector addition. The cost to implement is small and the return will be high. Circuit modifications will reduce the cost of NaSH and produce a cleaner concentrate with less talc.

5.7.5 CMC evaluation

CMC will be used in the cleaners for talc depression. A dosing system needs to be installed and testing on plant pulps to optimise the dose rate. If too much CMC is used this could depress copper.

5.8 Geometallurgical approach

Geometallurgy relates to the practice of combining geology or geostatistics with metallurgy, or, more specifically, extractive metallurgy, to create a spatially or geologically based predictive model for mineral processing plants. It is used in the hard rock mining industry for risk management and mitigation during mineral processing plant design and operation.

Applying geometallurgical modelling techniques can directly reduce the risks associated with meeting production targets in terms of Toromocho copper recovery, concentrate grade and arsenic in concentrate. Geometallurgy has the potential to act on both the consequences and likelihood axes to decrease risk.

For the geometallurgical characterisation to have a real impact on the business, it must enable improved mine planning and ore scheduling to the plant. For this there needs to be a map of the physical characteristics identified as impacting the value drivers.

- Concentration of deleterious elements arsenic
- Talc distribution
- Hardness
- Grindability
- Mineral species and ‘mineral grade’
- Mineral liberation
- Metallurgical recovery
- Mining recovery
- Drillability
- Fragmentation
- Reagent consumption, and
- Smelter enabling characteristics.

Golder would strongly recommend the developing a geometallurgical model as soon as possible.

5.9 Current and future ore characterisation

5.9.1 Current ores

The metallurgical knowledge is based on the original Feasibility testwork that does not appear to consider the scale and complexity of both the talc in ore and arsenic levels reporting to concentrate. It does not reflect the current ore being treated or how to address the processing issues. The original test work took no account of significant ore variability did not include the talc and arsenic issues as well as lower copper recoveries because of the talc.

For each ore type of hornfels, potassic, serpentine magnetite, serpentine talc, actinolite-tremolite and fillic the metallurgical characteristics needs to be established in the laboratory based on drill core from the open pit. This way a database can be used for ore scheduling, blending and processing. It could be that some ores should not be mixed for optimum processing.

Critical knowledge gaps include”

- What is the loss by assay size fraction in tailings?
- What recovery is being achieved by each ore?
- What are the grind recovery, leach residence characteristics of each ore?
- What is the current hardness of each ore?

- Arsenic recovery by ore type?
- Moly recovery by ore type?
- Talc levels in each ore type?
- Concentrate quality from each ore type?
- Are there differences in lime consumption?
- What is the critical cyanide consumption?

5.9.2 Future ore

A similar programme needs to be developed in detail.

5.10 Continuous improvement programme

There is significant room for improvement in the Toromocho concentrator.

Continuous improvement planning is now common amongst many mining companies and recognises that a total quality management system is necessary to ensure participation from the operators, line management etc.

Once set up and maintained the benefits can be staggering and recognises that the people at the coal face know only too well what are the problems and solutions but need coaching to bring these matters out into the open.

- The culture is fire fighting which is understandable seven months after commissioning.
- There is no documented continuous improvement plan with costs and a schedule for implementation.
- The plant processing staff has been very innovative with the Plant Improvement presentation but this needs to continue on a wider scale.
- A priority project list needs to be developed and personnel assigned. There are good solutions being implemented but it is very limited.

6.0 INFRASTRUCTURE

Most of the planned infrastructure components have been completed or are nearing completion.

6.1 Railroad access

Rail access is functioning as planned with concentrate being transported by rail from the mine. Major consumables (Diesel fuel, grinding media, reagents) are delivered to site by rail.

Transportation of copper concentrate and molybdenum oxide will be from the site to the Port of Callao via the existing rail line between Callao and La Oroya that runs by the mill site. The railroad is operated by a Peruvian company and, per Aker Kvaerner (December 2007) in its current condition, has the capacity for the additional transportation of the Toromocho Project produced commodities.

The railroad is owned by the government but is operated under a 15-year concession agreement with FerroCarril Central Andino S.A. The concessionaire will upgrade the rail line and purchase rolling stock to accommodate the Toromocho traffic and will recoup the costs in the operating fees. A 1 km spur to connect the mill site to the existing rail line, six rail lines in the yard at the mill and a traveling bridge crane for loading unloading, are to be provided by MCP. MCP will complete the 1 km rail spur from the main rail line to the mill site by the end of 2012 (Figure 73).

Figure 73: Toromocho concentrate spur line and main rail line

6.2 Access roads

Road access to mine site and process plant are through security gates with no general public access allowed.

Access to the site has been provided to the site by two roads. The Central Highway (paved), which is to be rerouted, will feed into the north access road to the administration area. A new access road, running parallel to the rail road will provide access to the site for local personnel. The new access road is completed, as with all other internal roadways by MCP.

6.3 Camp facility

Two accommodation camps are available at site each with dormitories, recreation rooms, mess hall, medical facilities and offices for camp administrators. The larger of the two accommodation camps being adjacent to the processing facility (Figure 74).

Camp facilities include a construction camp to be constructed approximately 12 km to the east of the mine site in the vicinity of the Central Highway.

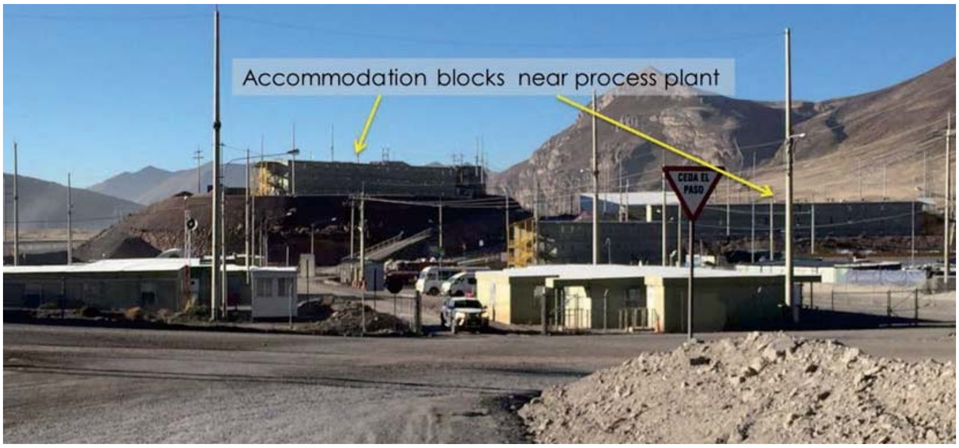


Figure 74: Accommodation blocks and camp adjacent to process plant facility 2016-July-27

6.4 Office and administrative support facilities

Administration buildings are completed at both the mining operations and processing operations.

The non process buildings to house administration, mine truck shop, and maintenance will be constructed to provide office facilities for the administration and maintenance staff. In addition, facilities will be constructed to house analytical and metallurgical laboratories, reagent storage, fuelling stations, explosives storage, and the camp facility.

6.5 Material and supply storage and distribution

A temporary mine truck workshop has been installed enabling the current fleet of trucks and mobile equipment to be serviced under cover. Permanent mine maintenance facilities and supporting warehouse have been deferred.

Warehousing will be located in the maintenance shop building adjacent to the concentrator.

Other supply inventories will be contained in the fuel stations, reagent building, explosives storage, and mine truck shop.

6.6 Town site

The old town of Morococha has been partially demolished with only a handful of residential dwelling remaining, occupied by residents yet to voluntarily relocate to the new town of Morococha.

6.7 Heap leaching project for high arsenic ore

Leaching project for High-Arsenic copper ore is at Concept stage with options being evaluated, currently on hold.

6.8 Lime quarry project

The Lime project was suspended in September 2014 due to community issues and is currently on hold, but estimated to be some 72% complete. The kiln and materials handlings systems have been purchased representing some 65% of the budgeted total cost. Only minor items are remaining for purchase. The project is currently on care and maintenance.

6.9 Water supply

Mine Drainage Phase 2 should be completed during 2016 to allow mine water to drain into the Kingsmill tunnel, with the raise boring planned to commence in August 2016.

Mine Drainage Phase 3 expected to be completed during 2016.

The total water demand by the Toromocho plant for an average year will be 8.65 million m^3. Water will be supplied from the Kingsmill Tunnel. Only 50% of the treated flow from the Kingsmill Tunnel will be required for plant process water. Culinary water will be supplied to the site from a reverse osmosis and chlorination system.

6.10 Electrical power supply

- The electric power supply is described by a report prepared by CESEL Ingenieros, Peru. The electric power will be delivered from a 220-kV substation near the township of Pomacocha.
- A new 11 km, double circuit overhead transmission line will be installed and routed from the Pomacocha Substation to the main substation at Toromocho. The new transmission line can deliver 220 MW on either circuit.
- A third 220-kV incoming power source will be provided by using the existing Mantero III transmission line. This line will serve as emergency back-up only.
- The project with a triple redundant system should experience a minimum of unexpected or unscheduled delays due to power outages.
- Emergency standby power will be installed to operate the large paste thickeners, the conventional tailings thickeners, the concentrate thickeners, camp medical facilities, etc.

6.11 Miscellaneous infrastructure

Included in miscellaneous infrastructure are compressed air systems, sewage treatment, fire protection, security, and communications.

7.0 ENVIRONMENTAL AND PERMITTING

The environmental and permitting aspects related to the project appear to have been addressed adequately and Chinalco has demonstrated both good faith and expediency in relation to a spill in March 2014. Golder is not aware of any subsequent complaints raised against Chinalco.

There are no known environmental or permitting issues outstanding that pose notable risk to the project that Golder is aware of.

8.0 RECLAMATION AND CLOSURE

In terms of mine closure, as this project is expected to be a long-life operation (>30 years), the conceptual closure plan provides for progressive and final closure of all major facilities. Those facilities include the pit, waste dumps, process plant area, shops, and other areas with concrete laydown pads, limestone quarry, and access roads.

9.0 ADMINISTRATION, MANPOWER, AND MANAGEMENT

Golder would support the view that the management, administration, and engineering/operating personnel are highly respected in the industry, experienced in their respective roles, and dedicated to the success of the Toromocho Project.

The staffing levels in the various support categories appear to be currently adequate.

10.0 CAPITAL COST ESTIMATE AND IMPLEMENTATION SCHEDULE

The majority of the capital expense for the project has been incurred with some lesser items having been deferred. The Lime quarry, permanent mining workshops, completion of the molybdenum processing circuit are items that are presently outstanding. The construction of the Tailings dam appears to be progressing satisfactorily.

The project is in production and has been exporting concentrate for over 12-months. Continuing work to improve recovery levels and throughput tonnages at the process plant have been covered elsewhere in this report.

11.0 OPERATING

Operating procedures and practices have been covered elsewhere in this report and it is believed that MCP has a thorough understanding of the focus areas for further improvement.

12.0 MARKETING AND SALES

Marketing and sales have been impacted by the high levels of Arsenic in copper concentrate, this is an area that will require ongoing effort by MCP to satisfactorily address as smelters around the world become less willing to accept high levels of Arsenic in concentrate. There exist several options available to MCP to address in part or completely the issue regarding Arsenic in concentrate, these have been addressed elsewhere in this report.

13.0 ECONOMIC ANALYSIS

See Sections 4.6 through 4.10 for financial assessment of the current project.

14.0 RISK

The primary risk remains the current net income from the copper sales, with the reduced income from a low copper price being compounded by large penalty costs associated with the Arsenic levels in concentrate.

Report Signature Page

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Golder Associates

A. VALUATION REPORT FOR THE TOROMOCHO PROJECT

The following is the text of the valuation report from the Competent Evaluator in respect of the Toromocho Project for the purpose of incorporation into this Scheme Document.

23 January 2017

REPORT

CHINALCO MINING CORPORATION INTERNATIONAL

Valuation Report for Toromocho Copper Project

Submitted to:
Chinalco Mining Corporation International

Report **Number** 168511012 R.001_Rev15

Golder Associates

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1.0 INTRODUCTION

This report is prepared solely for the use of the directors and management of the Company. The Company is Chinalco Mining Corporation International. In addition, Golder Associates (hereinafter referred to as "Golder") acknowledges that this report may be made available to the Company for public documentation and disclosure purposes.

This report has been prepared in accordance with guidelines set by the Code for the Technical Assessment and Valuation of Mineral and Petroleum Assets and Securities for Independent Expert Reports 2015 Edition (the "VALMIN Code"), although readers should note that the basis for such Ore Reserves and Mineral Resources do not comply with the JORC Guidelines (2012) in relation to the preparation and disclosure of an Ore Reserves and Mineral Resources Statement. Nonetheless, Golder has reviewed and assessed the Mineral Resources and Ore Reserves published in the 2015 Annual Report against the JORC Guidelines (2012), Golder believes such Mineral Resources and Ore Reserves to be a fair representation of the Toromocho Project and that the Ore Reserves are inclusive of all required modifying factors and that the Ore Reserves estimate is appropriate and correct based upon the underlying assumptions for the Toromocho Project. Further, we are of the opinion that there is no need for discounting the value of mineral resources and ore reserves as reported in the 2015 Annual Report. CMC has also confirmed that as at the Latest Practicable Date, there has been no material change in the Mineral Resources and Ore Reserves since 31 December 2015, other than decline due to normal operations.

The valuation was carried out on a Fair Market Value basis. Fair Market Value is defined as ''the amount of money (or the cash equivalent of some other consideration) determined by the Expert in accordance with the provisions of the VALMIN Code for which the Mineral or Petroleum Asset or Security should change hands on the Valuation Date in an open and unrestricted market between a willing buyer and a willing seller in an ''arm's length'' transaction, with each party acting knowledgeably, prudently and without compulsion''

The valuation contains estimations and forecasts based on data provided by Chinalco Mining Corporation International ("CMC" or "Chinalco") as well as those contained in the report entitled ''Competent Persons Report for Toromocho Project" (the ''CPR''), prepared by Golder Associates (''Golder'').

By agreement with the client the valuation date is 2 December 2016 and this report has been prepared on the basis of project information available up to that date unless as specifically stated in the text. This report has been prepared on the basis of project information available up to the Valuation Date. The opinions expressed herein are given in good faith and we believe that any assumptions or interpretations made by it are reasonable.

Golder has adopted a discounted cash flow (DCF) method under the income approach for the valuation of the Project and has used a market approach comparable transaction analysis for the purpose of comparison.

In this valuation, all monetary values are expressed in the currency of the United States of America.

2.0 OVERVIEW OF TOROMOCHO COPPER PROJECT

The Toromocho Copper Project is located in Peruvian Andes approximately 140km East of Lima. In August 2007 Chinalco acquired all the shares of Peru Copper Inc., owner of Minera Peru Copper, which is now Minera Chinalco Peru S.A, and on May 5th of the following year (2008) signed the transfer of concessions and mining assets contract of the Toromocho Project.

Maps, plans, and other information showing the geotechnical location of the Toromocho Cooper Project is presented in Section 2.0 of our CPR.

The Toromocho Project consists of a total of 67 key mining concessions, with registered superficial land rights covering 6,702.8 hectares. We are of the view that these 67 mining concessions to be the Project's key mining concessions because each of them is either within the designed open pit and essential for the mining activities or is located near the designed open pit and important for future expansion. 66 of these key mining concessions are wholly-owned by members of our Group. Meanwhile, one of the key mining concessions in the Toromocho Project is owned by an independent party, in which we hold a 50% equity interest.

We have made inquiry into the status of these concessions and understand these is no material change to the concessions since 2012. We are of the view that these concessions are in good standing. Please refer to Appendix 1 for Details of the concession.

The project commenced ore feed to the Crusher in December 2013 with copper concentrate being produced throughout 2014 and 2015. Tonnage build up within the process plant has been rapid with some 84% of design throughput having been achieved in 2015. The annual production metrics for the process plant for 2014 to 2015 are shown below (Table 1).

Table 1: Toromocho Project production statistics 2014-2016

	2014	2015	2016 (Estimate)
High Grade Mill Ore (Mt)	19.7	36.1	38.3
Low Grade Mill Ore (Mt)	1.1	0	2.7
Total Mill Ore (Mt)	20.8	36.1	41.0
Head Grade Cu (%)	0.562	0.538	0.604
Head Grade Ag (g/t)	7.310	6.416	5.416
Copper Recovery (%)	60.00	83.08	79.86
Recovered metal (Cu Tonnes)	70,263	161,518	197,754
Concentrate Dry Tonnes	297,698	676,449	833,977
Arsenic Grade in conc. (%)	unknown	1.047	0.865

Source: Competent Person's Report (CPR) by Golder

Although tonnage build up has been relatively satisfactory, the metallurgical recovery in 2016 has been lower than expected primarily because of issues with talc in the ore feed (Table 2). The high Arsenic in concentrate has resulted in high penalty costs for treatment and refining costs. The molybdenum circuit has not been commissioned to date but is understood to be well advanced.

Table 2: 2016 Actual performance January to May

		Jan	Feb	March	April	May	YTD
Tons milled	DMT (kt)	2,770	2,230	2,401	2,973	3,064	13,439
Head Grade - Cu	%	0.61	0.51	0.58	0.6	0.64	0.59
Cu Recovery in Cu concentrate	%	73.63	77.03	73.08	72.22	70.61	72.96
Head Grade - Ag	g/t	6.14	6.90	5.98	7.22	7.13	6.70
Ag Recovery in Cu concentrate	%	59.71	69.40	64.97	58.96	55.59	61.03
Head Grade - Mo	%	0.01	0.01	0.01	0.01	0.01	0.01
Head Grade - Zn	%	0.09	0.1	0.11	0.09	0.14	0.11
Head Grade - As	%	0.03	0.04	0.03	0.04	0.03	0.03
Copper Concentrate Produced	DMT	55,693	40,232	52,658	68,881	72,382	289,847
Grade - Cu	%	22.26	21.82	19.43	18.55	19.15	20.03
Grade - Zn	%	3.23	4.47	3.65	2.79	3.83	3.53
Grade - As	%	0.82	1.20	0.83	0.92	0.65	0.86

		Jan	Feb	March	April	May	YTD
Copper content	DMT	12,398	8,779	10,231	12,778	13,864	58,049

Source: Competent Person's Report (CPR) by Golder

Copper will account for some 80% of the recoverable value from the project over the life of the mine and thus maximising the metallurgical recovery from the copper is vitally important. Ramp-up and commissioning has also coincided with a decline in copper prices that has resulted in significant financial pressure on the project. Total capital cost to date for the project has amounted to some US$4B including finance charges.

In reviewing the Toromocho Project and preparing the CPR, Golder believes that the overall project remains technically sound, but has reservations about the ability of the project to deliver a satisfactory return on investment without the Expansion Option case. Taking the Toromocho Project as it stands today with a mill design throughput of some 42.8 Mtpa in all but the most optimistic pricing scenarios fails to meet a satisfactory level of financial return. Whilst the expanded case option, targeting some 62.0 Mtpa appears to be more financially attractive, it would seem unwise to commit to any further expansion currently until a full understanding of the talc recovery issues and future mitigation of arsenic levels in concentrate are better understood.

3.0 SCOPE OF WORK/PURPOSE

The purpose of this valuation is to express an independent opinion on the Fair Market Value as at 2 December 2016 (the "Valuation Date") of the Toromocho Project.

Our valuation conclusion is based on the assumptions stated herein and the information provided by the management of the Chinalco Mining Corporation International.

Separate from this valuation study, Golder prepared a Competent Person's Report (CPR) for the Toromocho Copper Project in December 2016.

In preparing this report, we have had discussions with the Management in relation to the development, operations and other relevant information of the project. As part of our analysis, we have reviewed such financial information and other pertinent data concerning the Toromocho Copper Project provided to us by the Management and have considered such information and data as attainable and reasonable.

We have no reason to believe that any material facts have been withheld from us.

4.0 COST

The cost for carrying out the above scope of work is USD 50,000. The fee or the provision of further work to the Practitioner are not dependent on the:

a) Conclusions of the Technical Report; or

b) Success or failure of the reason for which the Valuation Report was commissioned.

We confirm that time and cost constraints did not compromise the fundamental principles of the VALMIN Code.

5.0 BASIS OF VALUATION

Our valuation is conducted on a Fair Market Value basis. Fair Market Value is defined as "the amount of money (or the cash equivalent of some other consideration) determined by the expert in accordance with the provisions of the VALMIN Code for which the mineral or petroleum asset or security should change hands on the valuation date in an open and unrestricted market between a willing buyer and a willing seller in an "arm'slength" transaction, with each party acting knowledgeably, prudently and without compulsion".

The Fair Market Value is usually comprised of two components, the Technical Value of the Project, and a premium or discount relating to market, strategic or other considerations. The VALMIN Code defines Technical Value as ''an assessment of a mineral asset's future net economic benefit at the valuation date under a set of assumptions deemed most appropriate by a relevant expert or specialist, excluding any premium or discount to account for such factors as market or strategic considerations.''

In keeping with the requirements of the VALMIN Code, a range of values and a preferred value have been calculated for the project.

Our investigation included discussions with members of the Management in relation to the development and prospect of the copper mining industry worldwide, and the development, operations and other relevant information of the Toromocho Copper Project. In addition, we have made relevant inquiries and obtained further information and statistical figures regarding the copper mining industry from external public sources as we considered necessary for the purpose of the valuation.

The valuation of the Mines requires consideration of all pertinent factors, which may or may not affect the operation of the Business Enterprise and its ability to generate future investment returns. The factors considered in our valuation include, but are not necessarily limited to, the following:

- The nature and prospect of the Toromocho Copper Project;
- The financial condition of the Toromocho Copper Project;
- The economy in general and the specific economic environment and market elements affecting the businesses, industries and markets;
- Relevant licences and agreements;
- The business risk of the project such as the ability in maintaining competent technical and professional personnel; and
- Investment returns and market transactions of entities engaged in similar mineral assets.

6.0 STATEMENT OF COMPETENCE

This report is prepared by the Golder team led by James Wang, Principal and Technical Director, and assisted by Ted Minnes, Alva Kuestermeyer, and Greg Griffith. Mr. Wang has over 20 years of experience in mining and due diligence assessment of mining projects and has completed a number of mining project valuations. Mr. Wang is nominated as an ''Specialist", under the terms of the VALMIN Code. Mr. Wang is the author and the competent evaluator of this report and has reviewed all the major assumptions adopted in the valuation model and ensured this valuation report is compliant with VALMIN Code.

Mr. James Wang (Bsc.-1992, Msc.-1994, MBA-2015) is a registered Profession Engineer (PE) in the United States of America, a QP under the Mining and Metallurgical Society of America, a Principal at Golder, and has twenty-two years' experience in the international resources industry (mostly in the Americas), with more than ten years of recent experiences of valuing mineral assets of similar type. Mr. Wang is an expert in due diligence studies as well as mineral project and mine valuations. He has provided valuations and financial analysis of projects for mining companies engaged in mergers and acquisitions of metal mining assets in the Americas, Asia, and Africa. Recent examples are: (1) a gold project in western U.S.A. in 2009; (2) a number of copper-gold projects in eastern Africa in 2014-2015; (3) a number of base metal projects in Southeast Asia in 2011-2013; (4) a gold project in eastern Africa in 2011; and (5) a number of copper and gold projects in central Asia in 2011-2016.

Mr. Ted Minnes, an Associate and Mining Practice Leader at Golder, has 32 years of experience in mining, QP, is also a registered Profession Engineer (PE) in the United States of America and a QP under the

Mining and Metallurgical Society of America. Mr. Alva Kuestermeyer is a principal metallurgical engineer at Golder and with over 30 years of experience in mining and a QP under the Mining and Metallurgical Society of America. Mr. Greg Griffith is a senior mining engineer with extensive experience in mining project valuations in the Americas.

Mr. Minnes and Mr. Wang are responsible for Sections 5, 7 and 8 of this Valuation Report. Mr. Kuestermeyer and Mr. Wang are responsible for Sections 1, 2, and 9 of this Valuation Report. Mr. Griffith and Mr. Wang are responsible for Sections 3, 4, 6, 10, 11, and 12 of this Valuation Report.

7.0 SOURCES OF INFORMATION

In conducting our valuation of the Fair Market Value of the Project, we have reviewed information from several sources, including, but not limited to:

- Information on the Project including, but not limited to, presentations, prepared documentation, exploration data, mine planning, legal, marketing and financial data;
- The CPR;
- A site visit by our CPs;
- Interviews of management and employees of CMC; and
- Prior industry knowledge and continuing industry research.

As part of our analysis, we have reviewed such financial information and other pertinent data concerning the Toromocho Copper Project provided to us by the Management and have considered such information and data as attainable and reasonable. We have also consulted other sources of technical, financial and business information. We relied upon the information provided by and the parameters advised by Golder's Competent Person (CP) who has conducted site visits. We have discussed with our CP concerning the information of the project and the work done in the Competent Person's Report. Based on our experience and professional judgment, we considered that the opinions expressed by the CP and the information contained in the Competent Person's Report are appropriate for the purposes of this valuation.

8.0 VALUATION AND ASSUMPTIONS

There are two accepted approaches to obtain the fair market values of the project, namely the Market-Based Approach, and the Income-Based Approach (or the Business Case Approach/Discounted Cash Flow Approach) applicable to assets like the Toromocho Copper Project. Each of these two approaches is appropriate in one or more circumstances, and sometimes, two or more approaches may be used together. Whether to adopt a particular approach will be determined by the most commonly adopted practice in valuing mineral assets that are similar in nature.

8.1 Market-Based Approach

The market approach looked at comparable sales to provide an estimate of what other operating copper producers recently sold for and provide a high-level basis for the estimate of what a buyer may pay for Toromocho.

For the purposes of conducting the comparable transactional approach, Golder conducted research to identify transactions of similar-type assets sold in the market as a proxy to indicate the price that a buyer might pay for the property. In 2015, average copper price fell to US$2.50/lb from US$3.14 in 2014, the fourth consecutive decline from a high of US$4.00 in 2011 (see Figure 1 below). In 2015 and 1H 2016 there were 5 relatively large deals of operating copper mines considered with an aggregate enterprise value of US$3.505 billion for 14.2 billion lbs of contained copper in reserves (see Table 3 below). As summarized in Table 3, the average enterprise price paid in 2015 and 1H 2016 for copper in reserves in the 5 significant copper transactions was US$0.23/lb. Further, the median and reserve-weighted average enterprise price paid in these 5 significant copper transactions were US$0.22/lb and US$0.25/lb, respectively. We believe that the US$0.23/lb price for producing assets (based on reserves) is applicable to the Toromocho reserves.

Table 3: Selected Copper Producer Acquisitions (Since 2015)

Date	Acquiror	Target	Equity Value (US$MM)	Enterprise Value (US$MM)	Cu-Eq. (Bnlbs) 2P Reserves	Enterprise Value / Cu-Eq. 2P Reserves
06-07-2015	Southern Copper	El Pilar	$100	$100	1.7	$0.06
30-07-2015	Antofagasta	Zaldivar (50%)	$1,005	$1,005	2.8	$0.36
24-08-2015	Audley	Anglo Norte	$300	$300	1.8	$0.17
15-02-2016	Sumitomo Metal Mining	Morenci (13%)	$1,000	$1,000	2.9	$0.34
05-07-2016	Centerra Gold	Thompson Creek	$137	$1,100	5.0	$0.22
Simple Average						**$0.23**
Median						**$0.22**
Reserve-Weighted Average				**$3.505 (total)**	**14.2 (total)**	**$0.25**

Source: SNL Metals and Mining, and Golder's internal database

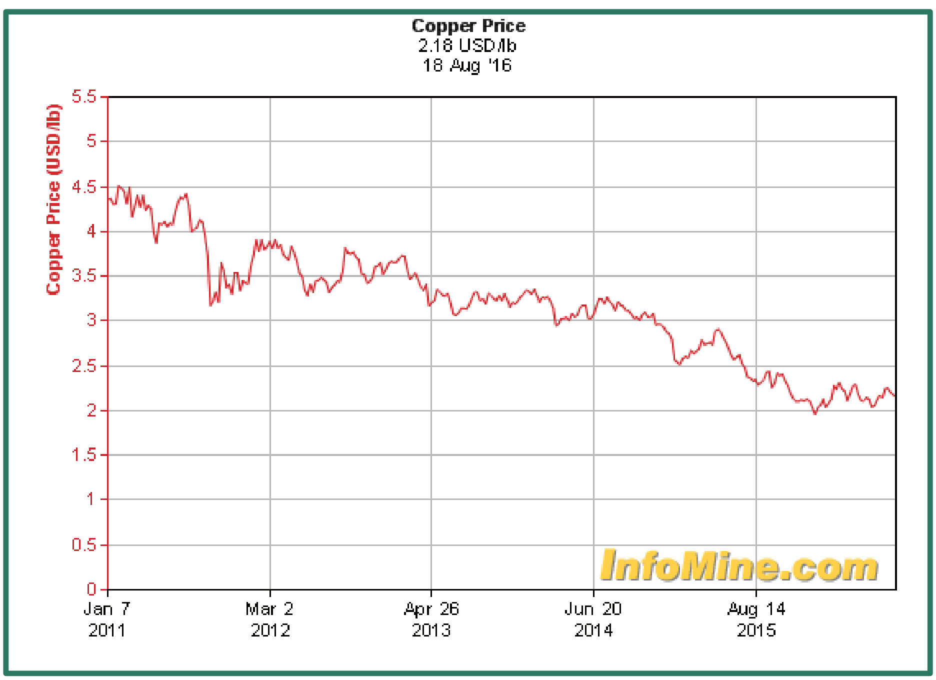

Figure 1: Historic Copper Prices

Factors Affecting Valuation

The US$0.23/lb average price paid in 2015 and 2016 will be influenced by numerous factors including:

- Project risk
- The change in copper price from 2015 to present

- Processing and refining penalties
- Incremental silver and molybdenum value

Peru is a relatively stable country for mining with country risk rating of 3 by OECD. The Competent Person's Report did not identify any fatal flaws but did point out the challenges faced by arsenic penalties, talc contamination, and harder ores.

It is clear that the purchase price is fundamentally related to current commodity prices as shown in Figure *2* below. However, purchasers may place some value on the potential for rising prices and the market consensus forecast shows a trend of prices increasing to about US$3.00 by 2020 and holding for the remainder of the mine life.

The Toromocho property has historically suffered from high penalties, predominantly associated with arsenic contamination. The mine plan provided by the Company shows de-creasing levels of arsenic from historic levels of around 0.9% to an average of 0.31% greatly reducing the arsenic penalty.

The value of the silver and molybdenum as a percentage represent 20% of the value of the metal in the ground. This percentage of added value from accompanying metals was typical for copper valuations of the operating companies sold in 2015 and 2016.

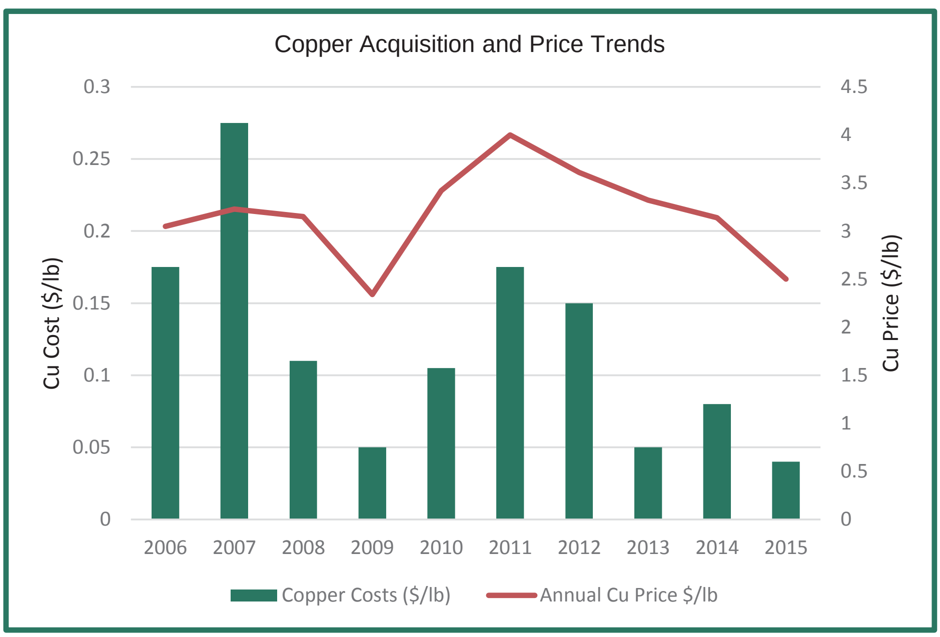

Figure 2: Copper Acquisition and Price Trends (SNL Metals)

Toromocho Mine Value Using Market Based Approach

The Toromocho mine is a producing property located in Peru. Based on the Competent Person's Report and data provided by the Company, reserves at Toromocho include approximately 6.93 million (per 2015 Company annual report) tonnes of copper or 9.45 million equivalent tonnes of copper after converting molybdenum and silver to copper based on the current commodity prices (see Table 4 below). As noted above, a review of 2015 and 2016 transactions shows that investors were paying an average of US$0.23/lb of copper for currently producing assets. However the price paid for any individual property can vary greatly and, without detailed analysis, this would be considered an indicative price.

Table 4: Valuation of Toromocho Project Using Market Based Approach

Toromocho Project 2P Reserves (As reported in 2015 Annual Report)

Category	Contained Metal (t)	Cu-Eq. Metal (t)	Cu-Eq. Metal (mmlb)	Convert Price (US$/t)	Convert Price (US$/oz or lb, as applicable)
Cu	6,930,000	6,930,000	15,278	4,409	2.00
Mo	279,000	1,046,250	2,307	16,535	7.50
Ag	10,100	1,473,096	3,248	643,087	20.00
	Cu- Eq. Total	9,449,346	20,832		
Average Enterprise Value / 2P (US$/lb)			0.23		
Implied Valuation for Toromocho Project (US$billion)			**4.79**		

Valuation Results and Sensitivity Analysis

Golder believes that the price decrease from 2015 and arsenic penalty are offset by the potential for increased prices and relatively stable environment to apply the US$0.23/lb price realized in 2015 and 2016. With reserves of 6.53 million tonnes of equivalent copper this would equate to an estimated equity value of US$4.79 billion for the case presented (see Table 4 above).

The following Figure 3 presents the result of our sensitivity analysis to the use of various realized price averages namely the simple average, the mean, and the reserve-weighted average of the major 2015 and 2016 copper transactions.

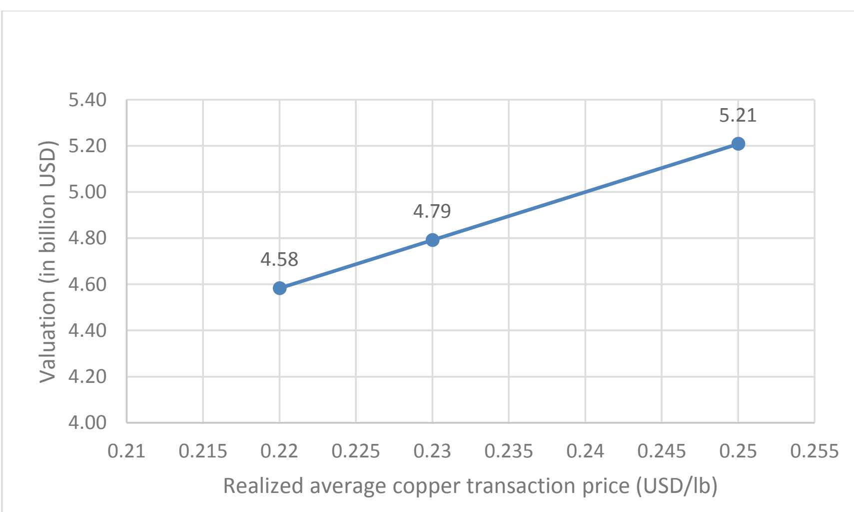

Figure 3: Sensitivity Analysis for Realized average copper transaction price

Note: Simple average of 2015-2016 transaction prices: US$0.23/lb
Mean of 2015-2016 transaction prices: US$0.22/lb
Reserve-weighted average of 2015-2016 transaction prices: US$0.25/lb

8.2 Income-Based Approach (Business Case Approach or BVA)

The Income-Based Approach focuses on the economic benefits due to the income producing capability of the mineral asset. The underlying theory of this approach is that the value of the mineral asset can be measured by the present worth of the economic benefits to be received over the useful life of the mineral asset. Based on this valuation principle, the Income-Based Approach estimates the future economic benefits and discounts them to their present values using a discount rate appropriate for the risks associated with realizing those benefits.

Under the Income-Based Approach, we have adopted the discounted cash flow ("DCF") method, which is based on a simple reversal calculation to restate all future cash flows in present terms. The expected free cash flow for each year was determined as follows:

Expected Free Cash Flow = Net Profit + Depreciation + After - Tax Interest Expense - Change in Working Capital - Capital Expenditure

The present value of the expected free cash flows was calculated as follows:

$PVCF = CF_1/(1+r)_1 + CF_2/(1+r)_2 + ... + CF_n/(1+r)_n$

In which

PVCF = Present value of the expected free cash flows;

CF = Expected free cash flow;

r = Discount rate; and

n = Number of years.

The Business Case Analysis is an income based approach that focuses on the economic benefits due to the income/cash flow producing capability of the mineral assets. The underlying theory of this approach is that the value of the mineral asset can be measured by the present worth of the economic benefits to be received over the useful life of the mineral asset. Based on this principle, the Business Case Analysis estimates the future cash flows of the mineral assets with appropriate projection methods and discounts such cash flows to present values using a discount factor appropriate for the risks associated with the operation of the underlying asset and the funding cost of the financial resources that support such operation.

Given the indicative nature of value derived under the Market Approach, the Business Valuation Approach is considered more applicable for the valuation of Toromocho. Toromocho is a current producer and as such good historical information was available to be used as part of the evaluation. Golder estimated cash flows based on the business case and projected prices provided by Company and referenced to the Competent Person's Report.

The business cases prepared by the Company also contain an expansion case. The expansion is also discussed in detail in the Competent Person's Report. However as pointed out in the Competent Person's Report, there are a few more pressing issues the Company needs to manage in order to achieve the projections in the current business plan, and therefore it presents uncertainties around when the expansion project can be delivered. As such, Golder has not considered the value of the expansion case in the Business Case Analysis. However a high level estimation of the valuation of such expansion will be discussed at the end of this section.

The valuation date of this report is 2 December 2016.

Business Projection-Reserves and Resources

Based on the Competent Person's Report and data provided by the Company, as of December 31st 2015, reserves at to Toromocho include approximately 6.53 million in situ metric tonnes of contained copper. We disclose that Golder didn't make a Mineral Resource and Ore Reserve Statement in the accompanying CPR. Golder is of the view that report of Mineral Resources and Ore Reserves conforms to the JORC code, the Mineral Resource and Ore Reserve have been estimated in a reasonable manner and the estimates appear to be reasonably reliable. Our opinion is that no discount shall be applied to the Ore Reserves estimate in the valuation exercise.

As stated in the accompanying CPR, Golder assessed the Toromocho Project against the JORC 2012 guidelines and Golder is of the opinion that the Mineral Resources and Ore Reserves quoted by Chinalco in the 2015. Annual Report is a fair representation of the Toromocho Project. The Mineral Resources were authored by Independent Mining Consultants (IMC) for Aker Kvaerner (Nov' 2007) as part of the Feasibility Study and have been reviewed by Dr Sia Khosrowshahi and are considered a valid representation of the mineral resource estimate for the project. The Ore Reserves were authored by Independent Mining Consultants for Aker Kvaerner (Nov' 2007) as part of the Feasibility Study and reviewed by Glenn Turnbull and considers the Ore Reserves to be inclusive of all required modifying factors and that the Ore Reserves estimate is appropriate and correct based upon the underlying assumptions for the Toromocho Project. We are of the opinion that there is no need for discounting the value of mineral resources and ore reserves as reported in the 2015 Annual Report. The Mineral Resource estimate for the Toromocho Project as of 31 December 2015 is shown in Section 3.16 of the Golder CPR as Table 35. The Ore Reserves estimated for the Toromocho Project as of 31 December 2015 is shown in Section 4.4 of the Golder CPR as Table 37.Further, as stated in the Golder CPR, the Mineral Resource and Ore Reserve estimates used in the CPR are information as of 31 December 2015, and Chinalco has not advised Golder of any material change, or event likely to cause material change, to the Mineral Resource and Ore Reserve estimates.

For the purpose of the Business Case Analysis, only Proved and Probable Reserves are included in the valuation, with no resources conversion included. The applied Reserves in the valuation has been adjusted to reflect the Production in the first half of 2016. Dilution and mining losses are considered as appropriate to the mine.

Below table reflects the ore reserve estimates that have been applied in the valuation.

Table 5: Toromocho Project Ore Reserves as at 31st December 2015

JORC Ore Reserve Category	Tonnes	Grade			Metal Content		
		Copper	Molybdenum	Silver	Copper	Molybdenum	Silver
	(Millions)	(%)	(ppm)	(gpt)	(Mt)	(tonnes)	(tonnes)
Proved	690	0.51	200	6.4	3.53	138,000	4,400
Probable	784	0.43	180	7.3	3.40	141,000	5,700
Total	**1,474**	**0.47**	**190**	**6.9**	**6.93**	**279,000**	**10,100**

Based on our review of relevant documents and discussion with our CP, we agree to the conclusion that the key concern of such historical underground workings is in relation to the protection of mining equipment and personnel as indicated in the CPR. We are of the opinion that the historical underground working issues would not impair our confidence of the Project's access to mineral resources.

As indicated in our CPR section 3 and 4, we are satisfied with the quality and reasonableness of the mineral resource and ore reserve estimates. We are of the opinion that they have been reported in accordance with the JORC 2012 Code.

Business Projection- Production Schedule

The mining and milling schedule used by Golder in the Business Case Analysis is prepared by the Company and reviewed in the Competent Person's Report. Generally speaking, the plan is to mine and process high grade ores in the beginning stages of the project while putting low grade ores and ores with high arsenic content into stockpile. After year 2035, the mining output of high grade ores gradually declines till complete depletion, the stockpiled ores will be reclaimed for processing. This plan is in line with standard practice of the industry with a goal to maximize the present value of Toromocho Project.

Since the Business Case Analysis does not consider the expansion of the project, the milling output will gradually reach 100% nameplate capacity by 42.8 Mt by 2020. As is discussed in the Competent Person's Report, a gradual improvement of recovery rate is factored in.

Other assumption regarding the production schedule considered in the Business Case Analysis, including the head grade of ores into the processing plant, the start time of the molybdenum production and moisture content in the concentrate, are all provided by the Company and reviewed in the Competent Person's Report.

Regarding arsenic content in the ore, the case prepared by the Company believes that the arsenic content level in the ore would gradually go down to 0.3% level after year 2019 as the mine goes deeper into the pit. However, high arsenic content would imply larger than industry standard penalty to the saleable concentrate from the mine, and Golder believes that the economic impact of such penalty is not immaterial in the meantime, the historical arsenic content level of the mine is approximately 0.9%. As a result Golder believes it is more prudent to use 0.6% as assumptions for arsenic content across the mine life of Toromocho Project.

In reviewing and preparing the production schedule and relevant assumptions, we have also compared the projection with historical realised production (which is provided in Table 1 and 2 of this report). We are of the opinion that the projection of production schedule is in line with the production track record in the commission phase and thus is reasonable.

Please refer to Figure 4 above for details of the projection assumptions.

	units /	2H 2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Avg. '26 - '50
Ore												
Low-grade mill Stockpiled	kt	15,084	27,880	24,910	23,480	32,780	24,150	27,180	9,850	0	0	0
High Arsenic Stockpiled	kt	736	1,360	506	606	448	37	1,839	480	21	0	47
High Grade Milled	kt	19,672	36,360	38,500	40,640	42,780	42,780	42,778	42,778	42,778	42,778	34,652
Total Mined	kt	49,009	89,890	91,116	93,526	95,488	95,287	97,407	95,408	94,889	95,078	64,546
Waste	kt	13,142	24,290	27,200	28,800	19,480	28,320	25,610	42,300	52,090	52,300	29,848
Total Ores Processed		19,672	36,360	38,500	40,640	42,780	42,780	42,778	42,778	42,778	42,778	42,742
Copper	percent	0.61%	0.61%	0.61%	0.63%	0.60%	0.54%	0.65%	0.46%	0.45%	0.47%	0.42%
Molybdenum	percent	0.01%	0.01%	0.02%	0.02%	0.02%	0.02%	0.02%	0.01%	0.01%	0.02%	0.02%
Silver	grams/t	3.13	8.05	6.14	6.77	6.21	6.22	5.46	5.29	4.62	5.34	6.18
Metallurgical Recoveries												
Copper	percent	76.5%	76.5%	76.5%	80.0%	82.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
Molybdenum	percent	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%
Silver	percent	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%
Recovered Metal												
Copper	M pounds	201.1	371.6	394.8	453.7	464.8	428.9	523.5	370.3	362.3	375.2	334.4
Molybdenum	M pounds	-	5.2	8.8	9.3	12.3	11.0	14.1	8.0	8.0	9.8	12.4
Silver	M Ounces	1.3	6.1	4.9	5.7	5.6	5.6	4.9	4.7	4.1	4.8	5.5
Concentrate Produced												
Copper	kt-dry	467	803	814	895	878	811	989	700	685	709	632
	kt-wet	513	882	894	983	965	891	1,087	769	753	779	695
Molybdenum	kt-dry	-	2.36	4.00	4.23	5.56	5.01	6.40	3.61	3.61	4.45	5.63
	kt-wet	-	2.36	4.00	4.23	5.56	5.01	6.40	3.61	3.61	4.45	5.63
Arsenic Grade in Conc	percent	0.60%	0.60%	0.60%	0.60%	0.60%	0.60%	0.60%	0.60%	0.60%	0.60%	0.60%

Figure 4: Production Schedule Projection Assumptions

Metallurgical Recovery Input

The original Company estimates for metallurgical recovery would be constant at 85% for copper and 65% for silver and molybdenum. With recent copper recovery of about 72% Golder believed that an 85% recovery beginning in 2017 was overly optimistic. However Golder is satisfied that sufficient effort was being applied at the Toromocho Project to better understand the blend requirements for the ore and to improve the metallurgical recovery up to the design specification through a variety of feed and process plant minor modifications. Golder assumed the copper recovery would be ramped up to meet the 85% target in 2021. This ramp-up was used for the valuation.

Concentrate Produced

The moisture is assumed to be 9% for conversion from dry ton of concentrate to wet ton of concentrate, as provided by the Company and reviewed by Golder. Concentrate grade was originally set to 24% but was ramped-up from current levels to 21% in 2017 and 24% in 2021.

Business Projection-Realization Cost

The realization cost mainly includes two part of cost items: 1) the costs charged by the smelters that purchase the concentrate; such costs include the treatment charge, refining charge and impurity penalties; and 2) the logistics costs that Company bears to ship the production from the mine to depot designated by the buyer.

As the specification of concentrate product produced by Toromocho Project deviates from the industry standard, the realization cost also differs to some extent from industry norm. As such, the assumptions Golder used in the Business Case Analysis is prepared by the Company with reference to the historical sales contract executed by Toromocho Project.

Also given the grade of copper concentrate produced by Toromocho is expected to be equal to or below 24%, it is typical that such products would be subject to a lower payability factor. Golder uses 95.8% payability factor as suggested by the Company.

Please refer to Figure *5* for details of realization cost assumptions.

	units /	2H 2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Avg. '26 - '50
Copper TC	USD/ton of dry concentrate	107.0	107.0	107.0	107.0	107.0	107.0	107.0	107.0	107.0	107.0	107.0
Copper RC	USD/ton of dry concentrate	43.9	47.2	49.5	51.9	54.3	54.3	54.3	54.3	54.3	54.3	54.3
Arsenic Penatly	USD/ton of dry concentrate	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
Silver Refining Charge	USD/ton of dry concentrate	1.1	3.2	2.4	2.6	2.5	2.8	1.8	2.7	2.4	2.7	3.7
Zinc Penalty	USD/ton of dry concentrate	5.1	5.1	3.8	4.4	5.3	1.4	4.3	1.4	1.4	0.5	3.7
Molybdenum Marketing Charge	USD/ton of dry concentrate	n.a.	661.4	661.4	661.4	661.4	661.4	661.4	661.4	661.4	661.4	661.4
Freight Cost	USD/ton of dry concentrate	92.7	92.6	92.6	92.6	92.6	92.6	92.6	92.6	92.6	92.6	92.7

Figure 5: Realization Cost Assumptions

Business Projection-Operational Cost

The operational costs used in the Business Case Analysis is prepared by the Company and reviewed in the Competent Person's Report. For valuation purposes, Golder thoroughly examined cost and / or expense items such as mining, stockpile reclaiming, processing, molybdenum-related cost, kingsmill, onsite admin and general services, transportation, freight and warehouse, legal, permit and community, centromin royalty and insurance. Furthermore, Golder applied a 1% per annum cost escalation to mining costs so as to factor in potential cost increase driven by deepening of mining and increasing height of waste dump. Golder is of the view that other operational cost will remain flat throughout the life of mine on a real term basis. Golder is of the view that the current cost assumptions represent reasonable assumptions of the future operation of Toromocho

Please refer to figure 6 for details of operational cost assumptions

Operational Cost	Unit	Life of Mine Average

Operational Cost	Unit	Life of Mine Average
Mining	USD/ton of total materials mined	1.32
Reclaim Stockpile	USD/ton of stockpile reclaimed	0.72
Process Plant	USD/ton of total ore processed	6.20
Moly Cost	USD/ton of high grade ore processed	0.47
Kingsmill	USD/ton of high grade ore processed	0.13
On-site Admin	USD/ton of high grade ore processed	1.20
Admin	USD/ton of high grade ore processed	0.26
Legal, Permit and Community	USD/ton of high grade ore processed	0.20
Insurance	USD/ton of high grade ore processed	0.27

Figure 6: Operational Cost Assumptions

The above assumed operational costs do not take into considerations of the credits from the sales of by-products including silver and molybdenum, which are directly included as part the top line revenue of the Toromocho Project.

Business Projection-Capital Expenditure and Working Capital

The capital expenditure schedule is provided by the Company. Golder has not included into the Business Case Analysis any capital expenditure items that are related to the expansion of the Toromocho project. Golder has compared the sustaining capital expenditure per annum provided in the schedule with those of similar mines and concluded that the level sustaining capital spending is reasonable for a project of this scale.

In the schedule provided by the Company, Golder notes that no re-habitation was provided. For an open pit operation of the scale of Toromocho project, Golder believes it is typical to factor in a required capital expenditure to complete the mine closure. As such a US$200MM spending is applied at the end of the mine life as a re-habitation cost.

Please refer to Figure 7 for details of capital expenditure assumptions.

	units /	2H 2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Avg. '26 - '50
Capital Expenditure	USD000s	-111,546	-148,876	-99,033	-45,888	-45,888	-45,888	-45,888	-153,738	-34,888	-34,888	-21,321

Figure 7: Capital Expenditure Assumptions

We have studied the working capital level of Toromocho Project by using the numbers in the 2016 First Half Result Announcement of the Company, and compared that with the working capital level of similar copper mine operations and copper mining companies. We believe as of Jun 30th 2016, the working capital level of Toromocho Project is at its long term sustainable level and there is no further need to put additional cash to fund the working capital in the long run.

Business Projection-Others

Other items considered by Golder in the Business Case Analysis include:

1. Employee Profit Sharing: According to the agreement between the Company and the Toromocho local community, the Company shares 8% of profit before tax to support local community. Such cash outflow is factored into the Business Case Analysis.

2. Depreciation and Amortization Schedule: The schedule used in the Business Case Analysis is provided by the Company. According to the Company, such schedule is consistent with its current accounting policies.

3. Corporate Income Tax: We understand that prior to 2014, the Company has signed a 15-year Stability Agreement with the Peruvian government that called for a 32% income tax rate for the Toromocho project up to Year 2028. In 2014 Peruvian Congress has approved a change of Corporate Income tax from the previous 30% to 26% in 2019. Golder's valuation analysis was based on an income tax rate staying at 32% until 2028 and then dropped to 26% for the remaining life of the Toromocho Mine.

Golder applied an 1.71% royalty on net revenue pursuant to the Toromocho option agreement entered into in 2003 with Empresa Minera del Centro del Peru S.A., a Peruvian state-owned mining company, also known as “Centromin”, which is also consistent with the royalty applied in the competent person report attached to the prospectus of the initial public offering of the Company.

4. Inflation: neither price inflation nor cost inflation was considered in our analysis

Metal Price Forecast and Revenue Projection

Golder has access to 22 research reports from major brokers and investment banks that studies metal price. These major brokers and investment banks cited are: CIBC, Deutsche Bank, Cormark, Raymond James, Canaccord, BAML, RBC, Macquarie, Barclays, BMO, Dundee, Haywood, Scotia, HSBC, NBF, GMP, UBS, Credit Suisse, Citi, JP Morgan, TD, and Societe General. Each report would give its own forecast of the metal price for the next few years and a long term price. The reports reflect the latest thinking of the future outlook of copper, silver and molybdenum. The metal price used in the Business Case Analysis is the average number of these reports. This the best available approach for select a future copper price estimate as these 22 major brokers and investment banks essentially represent all credible sources for future copper price projection. This approach has been routinely taken by other valuation consultants on similar work.

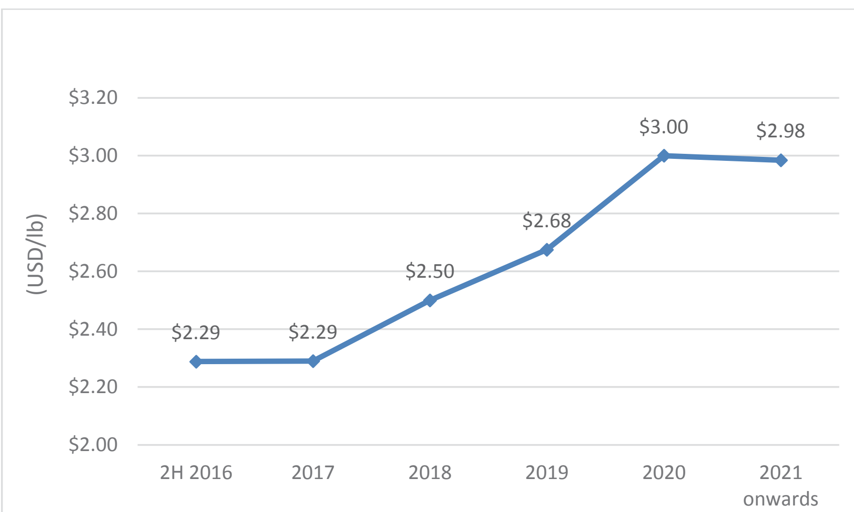

Figure 8: Copper Price Forecast (USD/lb)

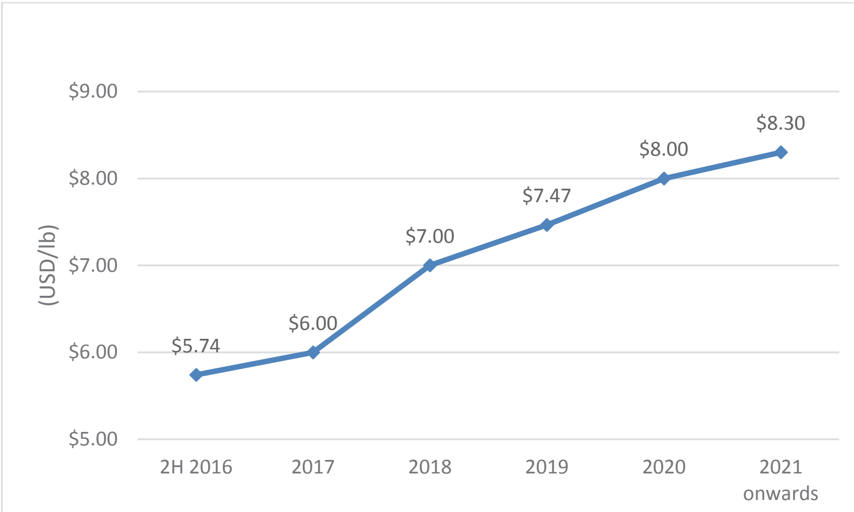

Figure 9: Molybdenum Price Forecast (USD/lb)

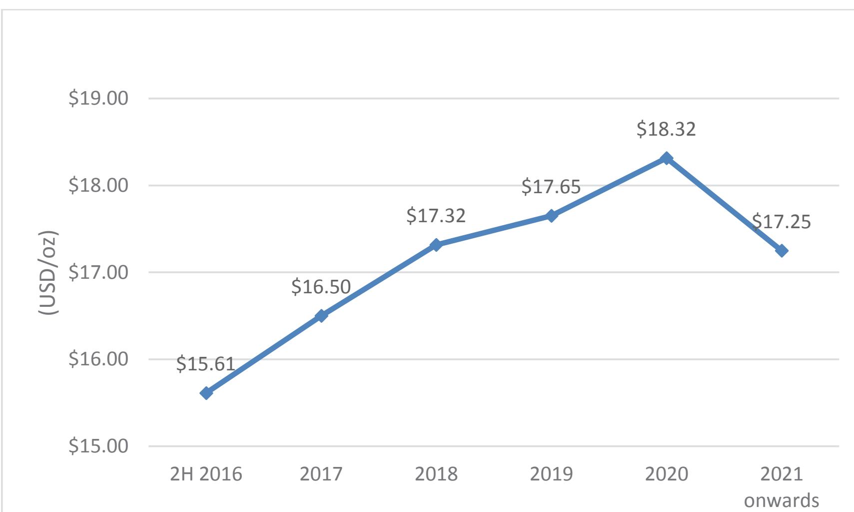

Figure 10: Silver Price Forecast (USD/oz)

Golder thoroughly reviewed historical sales records, offtake agreements and sales agreements of the Company, we have also examined product quality in the context of historical production and current resources and reserves. With that, Golder is of the view that the products the of the Company are marketable. Golder believes the gross revenue forecast below is reasonable based on the projected volumes and forecasted metal prices.

Gross Revenue	Unit	2H 2016	2,017	2,018	2,019	2,020	2,021	2,022	2,023	2,024	2,025	Avg. '26 - '50
Payable Copper	USD000s	438,208	810,464	942,090	1,160,903	1,336,278	1,226,856	1,497,382	1,059,404	1,036,473	1,073,162	957,172
Payable Molybdenum	USD000s	0	31,262	61,791	69,558	98,085	91,587	117,023	66,143	66,143	81,407	103,183
Payable Silver	USD000s	16,718	83,954	67,434	81,136	81,017	77,950	62,197	66,119	56,029	66,673	81,030
Total Revenue	USD000s	454,926	925,681	1,071,314	1,311,597	1,515,380	1,396,393	1,676,602	1,191,665	1,158,645	1,221,242	1,141,385

Figure 11: Silver Price Forecast (USD/oz)

Discount Factor

We have applied a discount rate of 7% based on the Company's projection of their Weighted Average Cost of Capital (WACC). In selecting the appropriate discount factor to be applied in the valuation, we have taken into account the traditional Capital Asset Pricing Model (CAPM) and several other factors including certain risks related to the operations of the project, our knowledge of discount rates commonly applied in valuing mining projects under the DCF method. We use the 10 year US treasury yield as the risk free rate, which we believe is the market normal practice. We studied the betas of comparable copper producers and believe a beta of 1.0-1.1 is a reasonable assumption and for a project like Toromocho. Other adopted assumptions on market risk premium, targeted capital structure, potential debt financing cost, and the tax rate are all based on market normal practice. We also considered the Peruvian country risk premium which is derived from Peru's country credit rating. We have also compared the result with other producing copper projects with similar risk profile and capital structure and concluded that 7% is a reasonable assumption for discount rate.

Implied Valuation under Income Approach

Implied Valuation of the Toromocho Project under the Income Approach is estimated to be US$4.47 billion based on the abovementioned assumptions. This reflects entire value of the Toromocho Project without considering the debt and cash it has loaded on the current balance sheet of the project or the Company. It is a prudent exercise to determine a range of Implied Value under the Income Approach based on an analysis of sensitivity to the most importance sources of uncertainty in the valuation inputs: the long term copper price, and the Discount Factor.

Our sensitivity analysis has established a range of Implied Value under the Income Approach of 3.84 to 5.14 billion US Dollars.

The following table presents the results of our sensitivity analysis for metal prices, discount rate, and metallurgical recovery, with those parameters moving up/down by 20%, two percentage points, and five percentage points, respectively. For valuation sensitivity on copper price and discount rate, the ranges that are not highlighted represent those scenarios of relatively low likelihood.

Valuation Sensitivity on Copper Price									
Long-term Copper Price (US$/lb)	2.38	2.53	2.68	2.83	2.98	3.13	3.28	3.43	3.58
Valuation (US$Bn)	3.23	3.54	3.84	4.12	4.47	4.80	5.14	5.40	5.71

Valuation Sensitivity on Moly Price									
Long-term Moly Price (US$/lb)	6.64	7.06	7.47	7.89	8.30	8.72	9.13	9.55	9.96
Valuation (US$Bn)	4.33	4.37	4.40	4.44	4.47	4.51	4.54	4.58	4.61

Valuation Sensitivity on Silver Price									
Long-term Silver Price (US$/oz)	13.80	14.66	15.53	16.39	17.25	18.11	18.98	19.84	20.70
Valuation (US$Bn)	4.35	4.38	4.41	4.44	4.47	4.50	4.54	4.57	4.60

Valuation Sensitivity on Discount Rate									
Discount Rate (%)	5.0%	5.5%	6.0%	6.5%	7.00%	7.5%	8.0%	8.5%	9.0%
Valuation (US$Bn)	5.65	5.31	5.01	4.73	4.47	4.24	4.02	3.82	3.64

Valuation Sensitivity on Copper Recovery Rate											
Copper Recovery Rate (%)	80.0%	81.0%	82.0%	83.0%	84.0%	85.0%	86.0%	87.0%	88.0%	89.0%	90.0%
Valuation (US$Bn)	4.05	4.13	4.22	4.30	4.39	4.47	4.56	4.64	4.72	4.81	4.89

Valuation Sensitivity on Moly Recovery Rate

Moly Recovery Rate (%)	60.0%	61.0%	62.0%	63.0%	64.0%	65.0%	66.0%	67.0%	68.0%	69.0%	70.0%
Valuation (US$Bn)	4.42	4.43	4.44	4.45	4.46	4.47	4.48	4.49	4.50	4.51	4.52
Valuation Sensitivity on Silver Recovery Rate											
Silver Recovery Rate (%)	60.0%	61.0%	62.0%	63.0%	64.0%	65.0%	66.0%	67.0%	68.0%	69.0%	70.0%
Valuation (US$Bn)	4.42	4.43	4.44	4.45	4.46	4.47	4.48	4.50	4.51	4.52	4.53

Figure 12: Sensitivity Analysis

We estimate that a 10% reduction in ore reserves would result in an approximately USD 150 million decrease in the valuation. This estimate is based on subtracting the volume of ore mined that equals to 10% of ore reserves at the end of mine life.

Discussion Regarding the Expansion

As discussed above, Golder has not considered the Phase 2 expansion of Toromocho Project in the Business Case Analysis. As pointed out in the Competent Person's Report, Golder still believes the expansion would deliver positive economic value. However, given the Company has other more critical short term targets to accomplish, such as improving recoveries and complete the molybdenum processing plants, Golder is of the view that there are still uncertainties regarding the timing of such expansion could be delivered. Based on the information provided by the Company, approximately an additional US$900MM of capital expenditure would be required to complete the expansion. Assuming the expansion could be delivered on or before 2021, a preliminary estimate of the value of the Toromocho Project would increase from US$4.62 billion to US$5.71 billion. The estimation is of indicative nature and should be used for reference only.

9.0 RISK FACTORS

The CPR report has provided extensive discussions in relates to the factors that potentially have impact on the operation and performance of the Toromocho Project. In preparing the valuation, we have reviewed and discussed all these factors. We are of the view that such risk factors have been properly taken into consideration into the valuation. We would include here a summary of such risk factors and provided with our subjective assessment of the consequences of the risk on the overall project operation and the likelihood of such risks occurring.

The risk assessment grid we apply is listed below:

	Likelihood		
Consequence	Likely	Possible	Unlikely
Major	High Risk	High Risk	Medium Risk
Moderate	High Risk	Medium Risk	Low Risk
Minor	Medium Risk	Low Risk	Low Risk

The likelihood of risks occurring is subjectively and estimated as:

- **Likely**: >50% probability that the risk will occur
- **Possible**: 20-50% probability that the risk will occur
- **Unlikely**: <20% probability that the risk will occur

The Consequence of risks is subjectively and estimated as:

- **Major**: >20% impact of mine cash flow, and potentially lead to mine closure if not corrected properly
- **Moderate**: 5-20% impact of mine cash flow but would not likely lead to a mine closure
- **Minor**: <5% impact of mine cash flow

Below is the summary of risks associated with Toromocho Project and our assessment:

- Risk related to mineral resources and reserves estimates – as discussed in section 8, we are comfortable with the mineral resources and reserves estimates. We believe there are limited risks that would impair Toromocho Project's ability to access the mineral resources in its concessions. In addition, given the mine of life for Toromocho Project is over 20 years, even there could be any factors (such as historical underground work) unexpected leads to certain amount of mineral resources available for extraction, due to the discounting factor, the value impact of such event is minimal, in our opinion. – ***LOW RISK***
- Risk related to mineral extraction and recovery – The Toromocho Project applies mining and processing method that is commonly used in similar mining operations. In our view, there is no significant risk associated with such process. As discussed in section 8 of this report as well as section 5 in the CPR report, there is more work to be done to improve the metallurgical recovery rate. If the final recovery could not achieve or get close to the level we applied in the business case, there will be a moderate consequence, but in our view such a risk is unlikely. – ***LOW RISK***
- Risk related to equipment and infrastructure of the operation – based on our review of the infrastructure, track record of production and management and maintenance policies, we believe there is limited risk associated with equipment and infrastructure – ***LOW RISK***
- Risk related to sales of the product – if the arsenic content level remains high in copper concentrate product produced from the Toromocho Project, which we believe is a possible event, this will have a moderate consequence, especially if this is compounded by a relatively depressed copper price environment. – ***MEDIUM RISK***
- Environmental and social-political risk – based on our own study and the review of the track record of the Toromocho Project, we are of the view that there is no significant environmental risk. Also the Company has a great relationship with local community and there has been no major social-political issue since the construction of the project. – ***LOW RISK***
- Country risk – Peru is one of the best performing economics in the Latin America, according to World Bank. The country has a sovereign credit rating of Standard & Poor's BBB+ with a positive outlook and A3 from Moody's. In our opinion, we don't see significant country risk – ***LOW RISK***
- Foreign Exchange Risk – we have studied the exchange rate between Peruvian Sol and U.S. dollar in the past ten years. The rate has been relatively stable and is moving within a range between 2.6 to 3.5 Sols to a U.S. dollar. We believe the volatility presented in the past 10 years indicates a relatively low risk profile in terms of exchange rates – ***LOW RISK***
- Global macroeconomic risk – it is possible that copper price would remain relatively low for a prolonged period of time. In particular, considering the fact that the Toromocho Project would run for another 20+ years into the future, it is likely that the copper price may deviate from the level we are applying in the valuation analysis. What worth mentioning is that, there is an equal likelihood that the future copper price may produce a positive surprise – ***MEDIUM RISK***

In Sum, we consider the overall risk profile for the Toromocho Project to be low, compared with other projects / operations of similar type or in nearby regions. In our view, the primary risk remains the current net income from the copper sales, with the reduced income from a low copper price being compounded by large penalty costs associated with the Arsenic levels in concentrate.

10.0 LIMITING CONDITIONS

The valuation reflects facts and conditions existing at the Date of Valuation being December 2, 2016.

We would particularly point out that our valuation was based on the information such as the projections made by the Management.

To the best of our knowledge, all data set forth in this report are reasonable and accurately determined. The data, opinions, or estimates identified as being furnished by others that have been used in formulating this analysis are gathered from reliable sources; yet, no guarantee is made nor liability assumed for their accuracy.

We have relied to a considerable extent on the historical and/or prospective information provided by the Management and other third parties in arriving at our opinion of values. The information has not been audited or compiled by us. We are not in the position to verify the accuracy of all information provided to us. However, we have had no reason to doubt the truth and accuracy of the information provided to us and to doubt that any material facts have been omitted from the information provided. No responsibilities for the operation and financial information that have not been provided to us are accepted.

Our conclusion of the fair market values was derived from generally accepted valuation procedures and practices that rely substantially on the use of various assumptions and the consideration of many uncertainties, not all of which can be easily quantified or ascertained. The conclusion and various estimates may not be separated into parts, and/or used out of the context presented herein, and/or used together with any other valuation or study.

We assume no responsibility whatsoever to any person other than the directors and management of the Company in respect of, or arising out of, the content of this report. If others choose to rely in any way on the contents of this report, they do so entirely on their own risk.

This report may not be reproduced, in whole or in part, and utilized by any third parties for any purpose, without the written consent and approval of Golder.

11.0 VALUATION CONCLUSION

Based on the investigation and analysis stated above, the valuation methods employed, and the sensitivity analyses performed, the implied valuation of the Toromocho Project as at the Date of Valuation, in our opinion, were reasonably stated as follows:

Aggregate Implied Project Value of the Toromocho Copper Project as of December 2, 2016

Valuation Method	Range US$	Preferred Value US$
Market-Based Approach	4.58 to 5.21 billion	4.79 billion
Income -Based Approach	3.84 to 5.14 billion	4.47 billion

We are of the view that the range of the value indicated above reflects the uncertainties of assumptions and risk factors discussed in section 8.2 and section 9.0 of this report.

We believe the income-based approach is a fair and reasonable assessment of the project's value. Income-based approach focuses on the economic benefits due to the income/cash flow producing capability of the mineral assets. This approach reflects the quality as well as quantity of the mineral asset. Admittedly, income-based approach does require quite a number of assumptions to be made. Market-based approach, on the other hand, applies a value multiple to the quantity of the mineral resources and ore reserves. Though requiring less assumption, it takes less into account the quality aspects of the asset. Our view is that the market-based approach typically severs as a reality check of whether the assumptions applied in the income-based approach is reasonable. Given the valuation from market approach is differs less than 10% to the income-based approach, we are of the view that the assumptions used in the income-based approach is generally in line with market expectation. As such, we conclude the preferred value represents the most likely scenario of projection.

When converting technical value to market value, investors typically look at price to net-asset-value ratio. This ratio represents a market transaction or trading value divided by its technical value assessed by independent evaluators. The average price to net asset ratios of the precedent transactions in table 3 of Section 8.1 is approximately 1.0x, with the range of 0.5x-1.2x. We think the average number of these cases represents the most reasonable ratio to be applied to Toromocho Project

As such, we are of the view that the project's Fair Market Value is US$4.47 billion.

We confirm that the inputs, assumptions, Valuation Approaches, Valuation Methods and Technical Assessment or Valuation meet the Reasonable Grounds Requirement as identified in the VALMIN Code.

We confirm that we meet the requirements of an "independent valuer" as defined in Appendix 1.1 of The HKIS Valuation Standards on Properties published by The Hong Kong Institute of Surveyors and, in addition, has no material connection with other parties to the proposed privatisation of the Company by Aluminum Corporation of China Overseas Holdings Limited by way of a scheme of arrangement (under section 86 of the Companies Law of the Cayman Islands).

12.0 APPENDIX I:

NO.	NAME	TYPE	CODE	DATE OF ACQUISITION
I.	**METALLIC MINING CONCESSIONS OWNED BY CHINALCO PERU**			
1	DANUBIO S.R.	Metallic Mining Concession	08021948X01	July 12, 2010
2	ISABEL S.R	Metallic Mining Concession	08021977X01	July 12, 2010
3	POLONIA S.R.	Metallic Mining Concession	08021978X01	July 12, 2010
4	VIENA S.R.	Metallic Mining Concession	08021976X01	July 12, 2010
5	MILAGROSA	Metallic Mining Concession	08001342Y01	November 19, 2004
6	ALIANZA	Metallic Mining Concession	08001063Y01	May 2, 2008
7	CHISPA	Metallic Mining Concession	08001496Y01	May 2, 2008
8	EL AZUL DEL DANUBIO	Metallic Mining Concession	08001349Y01	May 2, 2008
9	EL MARTILLO	Metallic Mining Concession	08001394X01	May 2, 2008
10	FORTALEZA	Metallic Mining Concession	08001143Y01	May 2, 2008
11	INDEPENDENCIA	Metallic Mining Concession	08005477X01	May 2, 2008
12	LA COMISIÓN	Metallic Mining Concession	08001807Y01	May 2, 2008
13	LA DEFENSA	Metallic Mining Concession	08001757Y01	May 2, 2008
14	LA PERLITA	Metallic Mining Concession	08001391X01	May 2, 2008
15	MADAM GRIMANEZA	Metallic Mining Concession	08001869Y01	May 2, 2008
16	SAN ROMÁN	Metallic Mining Concession	08000740Y01	May 2, 2008
17	SUERTE	Metallic Mining Concession	08001495Y01	May 2, 2008
18	VECINA	Metallic Mining Concession	08001479Y01	May 2, 2008
19	VECINA 2da	Metallic Mining Concession	08001996Y01	May 2, 2008

NO.	NAME	TYPE	CODE	DATE OF ACQUISITION
20	YANKEE	Metallic Mining Concession	08001824Y01	May 2, 2008
21	JUNIN	Metallic Mining Concession	08001124Y01	May 2, 2008
22	MONTAÑA-87	Metallic Mining Concession	08016662X01	May 2, 2008
23	MOROCOCHA 3-C	Metallic Mining Concession	0804354LY01	May 2, 2008
24	MOROCOCHA 3-D	Metallic Mining Concession	0804354MY01	May 2, 2008
25	MOROCOCHA 4-K	Metallic Mining Concession	0804355SY01	May 2, 2008
26	MOROCOCHA 4-L	Metallic Mining Concession	0804355TY01	May 2, 2008
27	MOROCOCHA 4-M	Metallic Mining Concession	0804355UY01	May 2, 2008
28	MOROCOCHA 4-N	Metallic Mining Concession	0804355VY01	May 2, 2008
29	MOROCOCHA 4-Ñ	Metallic Mining Concession	0804355WY01	May 2, 2008
30	MOROCOCHA 4-O	Metallic Mining Concession	0804355XY01	May 2, 2008
31	MOROCOCHA 6-C	Metallic Mining Concession	0804357IY01	May 2, 2008
32	MOROCOCHA 6-D	Metallic Mining Concession	0804357JY01	May 2, 2008
33	MOROCOCHA 6-F	Metallic Mining Concession	0804357LY01	May 2, 2008
34	MOROCOCHA 6-G	Metallic Mining Concession	0804357MY01	May 2, 2008
35	MOROCOCHA 7-A	Metallic Mining Concession	0804358CY01	May 2, 2008
36	MOROCOCHA-8	Metallic Mining Concession	10212693	May 2, 2008
37	MUCHCAPATA 4	Metallic Mining Concession	0804358AY01	May 2, 2008
38	MUCHCAPATA 5	Metallic Mining Concession	0804358BY01	May 2, 2008
39	TOROMOCHO CUATRO	Metallic Mining Concession	0804358EY01	May 2, 2008
40	TOROMOCHO DOS	Metallic Mining Concession	0804355ZY01	May 2, 2008
41	TOROMOCHO TRES	Metallic Mining Concession	0804357NY01	May 2, 2008
42	TOROMOCHO UNO	Metallic Mining Concession	0804354PY01	May 2, 2008
43	LA MADAMA	Metallic Mining Concession	08020930X01	July 12, 2010
44	CLAUDIA	Metallic Mining Concession	08021810X01	July 12, 2010
45	CONSTANCIA	Metallic Mining Concession	08001206Y01	January 9, 2006
46	EL SALCHICHÓN	Metallic Mining Concession	08002394Y01	November 19, 2004
47	SALVADOR	Metallic Mining Concession	08001027Y01	May 2, 2008
48	SYLVANA UNO	Metallic Mining Concession	10102105	March 10, 2006
49	TOROMOCHO UNO - 2011	Metallic Mining Concession	0804354SY01	May 2, 2008
II.	**METALLIC MINING CONCESSIONS OWNED BY PESARES**			
50	AFLICCIÓN	Metallic Mining Concession	08001997Y01	Acquisition of first interest in Sociedad Minera Pesares S.A. by Chinalco Peru on August 17, 2004
51	DOLORSITO	Metallic Mining Concession	08001999Y01	Acquisition of first interest in Sociedad Minera Pesares S.A. by Chinalco Peru on August 17, 2004
52	PESARES	Metallic Mining Concession	08001381Y01	Acquisition of first interest in Sociedad Minera Pesares S.A.

NO.	NAME	TYPE	CODE	DATE OF ACQUISITION
				by Chinalco Peru on August 17, 2004
III.	**METALLIC MINING CONCESSIONS OWNED BY CENTENARIO**			
53	ANCÓN	Metallic Mining Concession	08001837Y01	October 13, 2006
54	ASIA	Metallic Mining Concession	08001132Y01	October 13, 2006
55	CALLAO	Metallic Mining Concession	08001734Y01	October 13, 2006
56	EL JAPÓN	Metallic Mining Concession	08001811Y01	October 13, 2006
57	ELENITA	Metallic Mining Concession	08001858Y01	October 13, 2006
58	LA CHINA	Metallic Mining Concession	08001883Y01	October 13, 2006
59	LA MAR	Metallic Mining Concession	08001850Y01	October 13, 2006
60	LA SOLEDAD	Metallic Mining Concession	08000848Y01	October 13, 2006
61	TRANQUITA	Metallic Mining Concession	08001859Y01	October 13, 2006
62	VICTORIA	Metallic Mining Concession	08001944Y01	October 13, 2006
63	CHABELA	Metallic Mining Concession	08023100X01	October 13, 2006
64	CLARISA	Metallic Mining Concession	08023104X01	October 13, 2006
65	RAQUEL ELVIRA	Metallic Mining Concession	08022776X01	October 13, 2006
66	REBECA 90	Metallic Mining Concession	08023099X01	October 13, 2006
IV.	**METALLIC MINING CONCESSIONS OWNED BY JUANITA**			
67	JUANITA (Juanita de Hyo)	Metallic Mining Concession	08001163Y01	November 10, 2006

Figure 13: Mining Concessions

Report Signature Page

GOLDER ASSOCIATES CONSULTING LTD.

J.J. Wang

James Wang, P.E., M.B.A.
Principal, Technical Director

JJW/mz

Note: *Mr. James Wang is the author of the valuation report. He takes overall responsibility at the capacity of the Competent Evaluator. He has reviewed all the major assumptions adopted in the valuation model and ensured this valuation report is compliant with the VALMIN Code.* Mr. Wang has over 20 years of experience in mining and due diligence assessment of mining projects and has completed a number of mining project valuations. Mr. Wang is nominated as an ''Specialist", under the terms of the VALMIN Code. Mr. Wang is the author and the competent evaluator of this report and has reviewed all the major assumptions adopted in the valuation model and ensured this valuation report is compliant with VALMIN Code. *Mr. James Wang is a registered Professional Engineer (PE) in the United States of America.*

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