KINROSS

Manh Choh

A JV with Contango ORE

Manh Choh Project
Geochemical Characterization Report
Revision 1

Peak Gold, LLC

November 10, 2022

Prepared by

srk consulting

SRK Consulting (U.S.), Inc.

503000.040

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Geochemical Characterization Report
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Executive Summary

Introduction

Peak Gold LLC (Peak Gold) proposes to develop the Manh Choh Project with processing of the ore at Fairbanks Gold Mining Inc's (FGMI) Fort Knox Mine. The proposed mine would consist of two open pits (Manh Choh North Pit (North Pit) and Manh Choh South Pit (South Pit)). This geochemical baseline report describes the metal leaching (ML) and acid rock drainage (ARD) potential to support technical evaluations made on the Project and permitting application. This document has been updated from the previous version submitted December 31, 2021.

Geology

Gold-sulfide mineralization is preferentially hosted in calcareous schist units which are interbedded with quartz muscovite ± biotite schist unit (QMS) altered to amphibole – chlorite skarn. Calcite, dolomite, and minor siderite have been documented in Peak Zone and carbonates, in general, were noted to range from 2% to 25%. Sulfides were reported as predominantly comprised of pyrrhotite with lesser pyrite, chalcopyrite, sphalerite, arsenopyrite, bornite and trace covellite. Total sulfide abundance was estimated to range from 15% to 70%, depending on the degree of mineralization. Natural oxidation has occurred due to weathering processes and has been preserved as a result of the lack of regional glaciation in this part of Alaska. A significant portion of the Manh Choh North resource area is oxidized to depths in excess of 164 ft below surface.

Study Design

The aims of the geochemical characterization study are to define waste segregation criteria to inform mine planning, predict contact water chemistry (referred to as "source terms") for input into water quality assessments for the project and predict what influence processing Manh Choh ore will have on the Fort Knox tailings and associated water chemistry.

The characterization study used conventional procedures including acid-base accounting, trace element analysis, mineralogy, leach tests, humidity cells and onsite barrel tests. Some testwork is currently ongoing and this work is highly iterative with modifications expected to optimize the waste management approach and source term development.

Results

Waste Rock

Analysis of 96 waste rock samples showed that 83% of all oxide materials are classified as potentially acid generating (PAG) and there is a potential for rapid (i.e. during mining) onset of acidification of PAG waste rock in 35% of the QMS oxides and 68% of the skarn oxides.

The transition and sulfide materials are not likely to show rapid onset acid generation but there is still potential for acid generation in the longer term; 44% of the QMS sulfides and 74% of the skarn sulfides are classified as PAG. All types of waste rock showed some degree of elevated arsenic relative to a reference value of 10 times average global abundance for shale; highest concentrations occur in the skarn oxides and sulfides. Other parameters which were elevated in at least some of the waste rock samples were: silver, cadmium, cobalt, copper, lead, selenium. Highest concentrations were typically reported in the skarns.

Some of the oxide materials demonstrated acidic conditions in the initial stages of humidity cell testing but showed increasing trends in pH thereafter. The leachates from the majority of sulfide materials were circum-neutral but one of the QMS sulfides showed a decreasing trend to around pH 6 then stabilized. Arsenic was consistently mobilized in all humidity cells.

Ore and Tailings

Three ore samples before beneficiation have been analyzed comprising 1) Manh Choh Master Composite, 2) 20% Manh Choh Master Composite blended with 80% Fort Knox Composite and 3) 30% Manh Choh Composite blended with 70% Fort Knox Composite.

All ore samples are predicted to be PAG. Solid phase arsenic and silver were both more than 10 times average global abundance for shale in all three samples. The 30% blended composition also reported elevated copper and the Manh Choh Master Composite reported elevated cobalt, copper, molybdenum and selenium. Leachable arsenic, sulfate and manganese was reported in all ore samples during the Meteoric Water Mobility Procedure (MWMP) and total dissolved solids were elevated.

Mineralogy testing undertaken on the three ore samples showed pyrrhotite as the main sulfide mineral plus pyrite, chalcopyrite and arsenopyrite were also present. The acidic sulfate mineral, jarosite, was identified and calcite was reported as the only carbonate mineral. Humidity cell testing on the ore samples to Week 30 shows circum-neutral to moderately alkaline pH with variable arsenic mobilization occurring in all cells but showing no significant trends.

Following metallurgical testing on the ore samples, five detoxified residue tailings were submitted for geochemical characterization. The different residues represent different test conditions for the process simulations. Kinross is currently progressing the option of batch processing Manh Choh ore separately to Fort Knox ore, so no blending will be undertaken but all results are included for completeness on the Manh Choh Master composites and the blended materials.

Acid generating potential was consistent with the raw ore samples and all tailings are predicted to be PAG. Solid phase arsenic was elevated by more than 10 times average crustal abundance in all tailings samples and elevated cobalt, copper, molybdenum, silver, and selenium was also reported in one or more samples. Leachability was generally higher in the tailings samples than the raw ore samples and a number of parameters exceeded Profile II screening values in one or more samples including total dissolved solids (TDS), arsenic, antimony, sulfate, total nitrogen, and WAD cyanide.

The detoxified tailings solutions were also analyzed and generally showed higher concentrations than reported in the tailings MWMP leachates indicating a potential for elevated deleterious elements in the tailings porewaters. Concentrations of TDS, sulfate, arsenic, antimony, cadmium, copper, iron, manganese, total nitrogen, and WAD cyanide were elevated relative to Profile II screening values in one or more of the tailings solutions.

Construction Material Test Pit Samples

Analysis of 24 samples collected from test pits in the vicinity of the proposed road alignment and borrow pit sources showed that the acid rock drainage potential and long-term metal leaching potential for these materials is low. The leach tests reported some elevated concentrations of aluminum, copper and to a lesser extent manganese that were leached at concentrations above the most stringent Alaska WQ guidelines under mildly acidic to neutral pH conditions. Leaching of these parameters is likely a reflection of the conservative nature of the test procedure, and more representative of a potential initial flush rather than an indication of long-term release under field conditions. Elevated concentrations are not expected in the long-term if pHs remain near neutral in these materials as predicted.

Waste Classification Criteria

The geochemical characterization testwork available to date was used to develop recommendations for block model parameters used to predict the domains for waste rock management.

The proposed Manh Choh geochemical waste rock classification system consists of four waste rock management domains for oxide and four domains for transition/sulfide materials according to acid generating and/or metal leaching potential (Table 6-1 and Table 6-2). The material classifications inform mine planning waste segregation and development of the mine waste management plan (SRK, 2022).

Site specific neutralization potential / acid generating potential (NP*/AP*) ratios were developed for oxide and sulfide material. Oxide materials may generate acidity at low sulfur content and should therefore be classified using NP*/AP* only but sulfide and transition waste should be classified on NP*/AP* and sulfide content because at low sulfur concentrations, oxidation of small concentrations of sulfide produces low amounts of acid that can be readily neutralized by silicate minerals in addition to carbonate.

The time to onset of ARD was developed with consideration to the NP*/AP* of the sample and the overall rate of oxidation of sulfide. Oxidation rates were derived from humidity cells which have been running for more than two years. SRK predicted that rock with NP*/AP*<0.03 could generate acid during the short mine life.

Thresholds for metal leaching were developed for oxide and sulfide materials based upon arsenic/sulfur (As/S) molar ratios. Arsenic is identified as a parameter of concern and the expectation is that arsenic mobility will be different for sulfide and oxide materials due to a differences in mineralogical hosts. The molar ratios were developed using the relationship between As/S in solids and the rate of arsenic leaching indicated by humidity cell tests.

Contact Water Source Terms

Source terms were developed in consultation with Piteau who are responsible for the site wide water quality model. The contact water sources are:

- Runoff from waste rock dump surfaces during snowmelt.
- Runoff from waste rock dump surfaces during summer rainstorms.
- Waste rock dump porewaters.
- Pit backfill pore waters.
- Pit wall runoff.
- Infrastructure fill pore waters.
- Pit wall runoff for the exposed high walls in Manh Choh South Pit.
- Load out pad.

The source term concentrations should be viewed as “screening level” to evaluate project water quality effects against water quality standards. The results are not geochemical predictions (i.e., they are not ion balanced).

A number of input values were used; specific values were provided by Piteau and Peak Gold and generic values were based on professional experience. Average rates from humidity cell tests were used to calculate a range of non-acidic weathering rates based on the assumption that wastes will be managed to prevent the onset of acidification, or that mining will result in locally acid generating materials becoming mixed. Selected analog concentrations are used for certain parameters and it is intended that these values will be replaced with site specific knowledge as leach tests and on-site kinetic tests are monitored.

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The opinions expressed in this document have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. While SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data.

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Glossary

Abbreviation	**Unit or Term**
ABA	acid base accounting, a type of static test
AP	acid potential, calculated from sulfur as sulfide x 31.25, and expressed as parts per thousand calcium carbonate (kg $CaCO_3$/t)
AP*	site-specific acid potential
ARD	acid rock drainage
As/S	arsenic/sulfur ratio
Charge Material	solid material (rock or tailings) used for humidity cell testing
Dry disposal	waste rock disposed above the final water level and capped to limit water contact by infiltration
EC	electrical conductivity, a measure of the ion content of water
HCT	humidity cell test, humidity cell testing
ICP-MS	inductively coupled plasma mass spectrometry
Kinetic test	test indicating the rate at which a solid material will weather
Leachate	liquid collected following leaching of a solid material
Leaching rate	rate at which a parameter is leaching from the solid state into solution (expressed as mg/kg/week)
ML	metal leaching
MWMP	Meteoric Water Mobility Procedure
Neutral	in the context of water, a pH of 7
NAG	non-acid generating, non-potentially acid generating, or acid consuming
NP	neutralization potential
NP*	site-specific neutralization potential
NP/AP	ratio of neutralization potential to acid potential
Oxidation	reaction of oxygen or another oxidant with a mineral or removal of electrons from an ion
PAG	potentially acid generating or potential ARD generating
pH	negative logarithm of hydrogen ion concentration
Pyrite	mineral, iron-sulfide (FeS2)
QA/QC	quality assurance/quality control
QMS	quartz muscovite ± biotite schist unit
ROM	run-of-mine
Reduction	reaction resulting in a reduced ion
SEM	scanning electron microscope
SMWMP	sequential Meteoric Water Mobility Procedure
Static test	test indicating the potential for ARD to occur in a rock
SRK	SRK Consulting (U.S.), Inc. or other SRK entities
Sulfate	oxidized sulfur ion (SO4)
Sulfide	reduced sulfur ion
TDS	total dissolved solids
TIC	total inorganic carbon, a measurement of carbonate
TSS	total suspended solids
Wet disposal	waste rock disposed underwater, below the eventual pit water level
WRD	waste rock dump
XRD	X-ray diffraction, a method for determining types of minerals in a sample

Units of Measure

Abbreviation	**Unit or Term**
in	inches
kgCaCO$_3$/t	kilograms calcium carbonate per ton
mi	mile
cy	cubic yard
ft	feet
mg/kg	milligram per kilogram
mg/kg/week	milligram per kilogram per week
mg/L	milligram per liter
mm	millimeter
ppm	parts per million
µg/L	microgram per liter
g/mol	grams per mole
wt. %	weight percent

1 Introduction

1.1 Project Location

The Manh Choh Project is located in the Tetlin Hills and Mentasta Mountains of eastern interior Alaska, approximately 200 miles (mi) southeast of Fairbanks and 10 mi southeast of Tok (Figure 1-1). The proposed mine would consist of two open pits (Manh Choh North Pit (North Pit) and Manh Choh South Pit (South Pit)) with an active mine life of 4.5 years. The West Peak deposit and Discovery Zone are not included in this study.

Access to the Manh Choh Project will be via the Alaska Hwy to Tetlin Village Road, located approximately 6 mi east of the town of Tok. From the turnoff, the Manh Choh Twin Road (Twin Road) and the Tetlin Village Road are adjacent to one another for a distance of about 4 mi, which is over an alluvial plain. The Manh Choh Site Road (Site Road) then travels approximately 10 mi to the proposed mine and gains approximately 1,640 feet (ft) in elevation.

1.2 Project Description

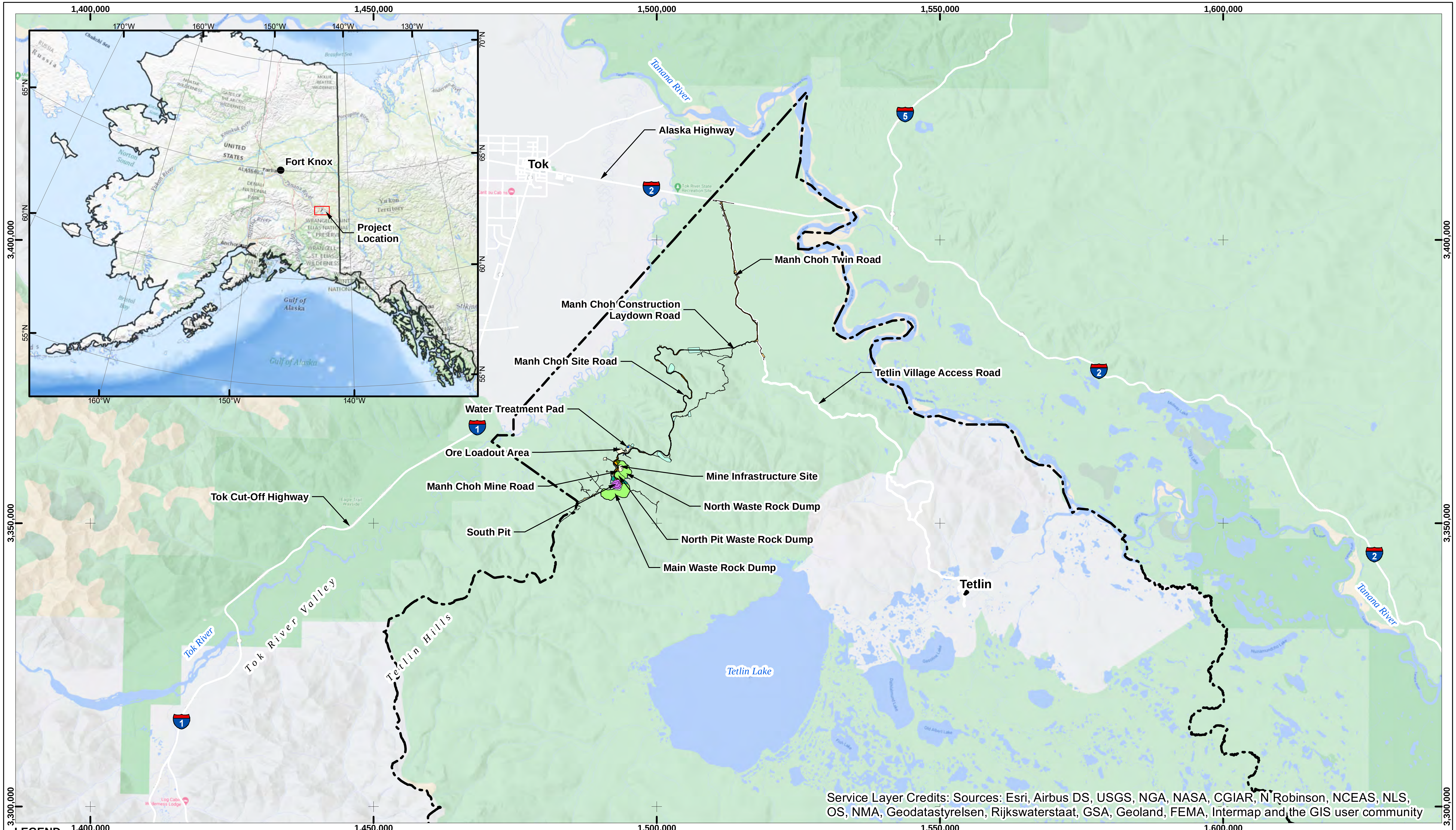
The Manh Choh Project consists of three components: mine development (Manh Choh Mine), ore transport, and ore processing. The proposed Manh Choh mine components include the North and South Pits, roads, waste rock storage, overburden storage, ore load out facility, explosives storage, fuel storage, and associated infrastructure. Prior to mining ore, the pit locations and other facilities will have the overburden (organic and developed soil horizons) stripped and stockpiled for later reclamation.

Ore will be segregated from waste rock (non-ore bearing) and the run-of-mine (ROM) ore will be hauled from the two pits by off road haul trucks to the ore transfer yard site where the ore will be loaded onto highway capable vehicles for transport to the Fort Knox Mine, near Fairbanks for processing.

1.3 Scope of Work

Peak Gold, LLC (Peak Gold) is the entity that owns the Manh Choh Project. KG Mining (Alaska) is the manager of Peak Gold, LLC. SRK Consulting (U.S.), Inc. (SRK) is conducting a geochemical characterization study on behalf of Peak Gold to support development of the Manh Choh Project and processing of the ore at Fairbanks Gold Mining Inc.'s (FGMI) Fort Knox Mine. The purpose of this study is to support the technical evaluations made on the Project and permitting application.

This work is highly iterative and modifications are expected to the mine design to optimize the waste management approach based on the segregation criteria and site-wide water chemistry predictions being developed by others.



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LEGEND

- 🟧 ROM Ore Stockpile
- 🟫 Access Road
- ⬛ Building
- 🟦 Water Treatment
- 🟦 Diversion
- 🟩 Waste Rock Dump
- 🟪 Pit
- 🟨 Existing Roads
- 🟫 Haul Road
- 🟩 Low Grade Ore Stockpile
- 🟩 Material Site
- 🟩 Overburden Stockpile
- ⬜ Yard
- Tetlin Lease Boundary

N

0 1.5 3

Miles

1 inch = 3 miles

REVISIONS		
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DRAWN: ML APPROVED: IJC
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IF THE ABOVE BAR
DOES NOT MEASURE 1 INCH,
THE DRAWING SCALE IS ALTERED

PREPARED BY:
srk consulting

PREPARED FOR:
KINROSS Manh Choh
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DRAWING TITLE:
GEOCHEMICAL CHARACTERIZATION REPORT
PROJECT LOCATION

DATE: 9/15/2022
REVISION: B
SRK PROJECT NO.: 503000.070-0600
DRAWING NO.: FIGURE 1-1

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1.4 Contributors

This report was prepared by SRK with input from the following organizations:

- Bureau Veritas Laboratories, Burnaby, BC, Canada
- Bureau Veritas Metallurgical Division, Richmond, BC, Canada
- McClelland Laboratories, Inc., Sparks, Nevada, USA
- Kinross Gold Corp.
- Piteau Associates, Kelowna, BC, Canada
- Shannon and Wilson, Inc. Fairbanks, Alaska

1.5 Limitations

This report presents interim results with data available at the time of preparation. A number of geochemical tests are still ongoing (refer to Section 1.1) and further updates will be presented as new data become available.

2 Background

2.1 Geological Setting

The description below is adapted from Van Treeck *et al*. (2013) and JDS (2018).

2.1.1 Host Rock Types

Figure 2-1 presents a general geological map of the Project area. The majority of the Manh Choh Project is hosted within the Yukon-Tanana Terrane, a regionally extensive package of greenschist to amphibolite facies metamorphic rocks of Mississippian or older age. Most of the project area escaped Pleistocene continental glaciation and is covered by a variable thickness of aeolian silt ranging up to 33 ft thick with extensive oxidation occurring some 197 to 295 ft below surface.

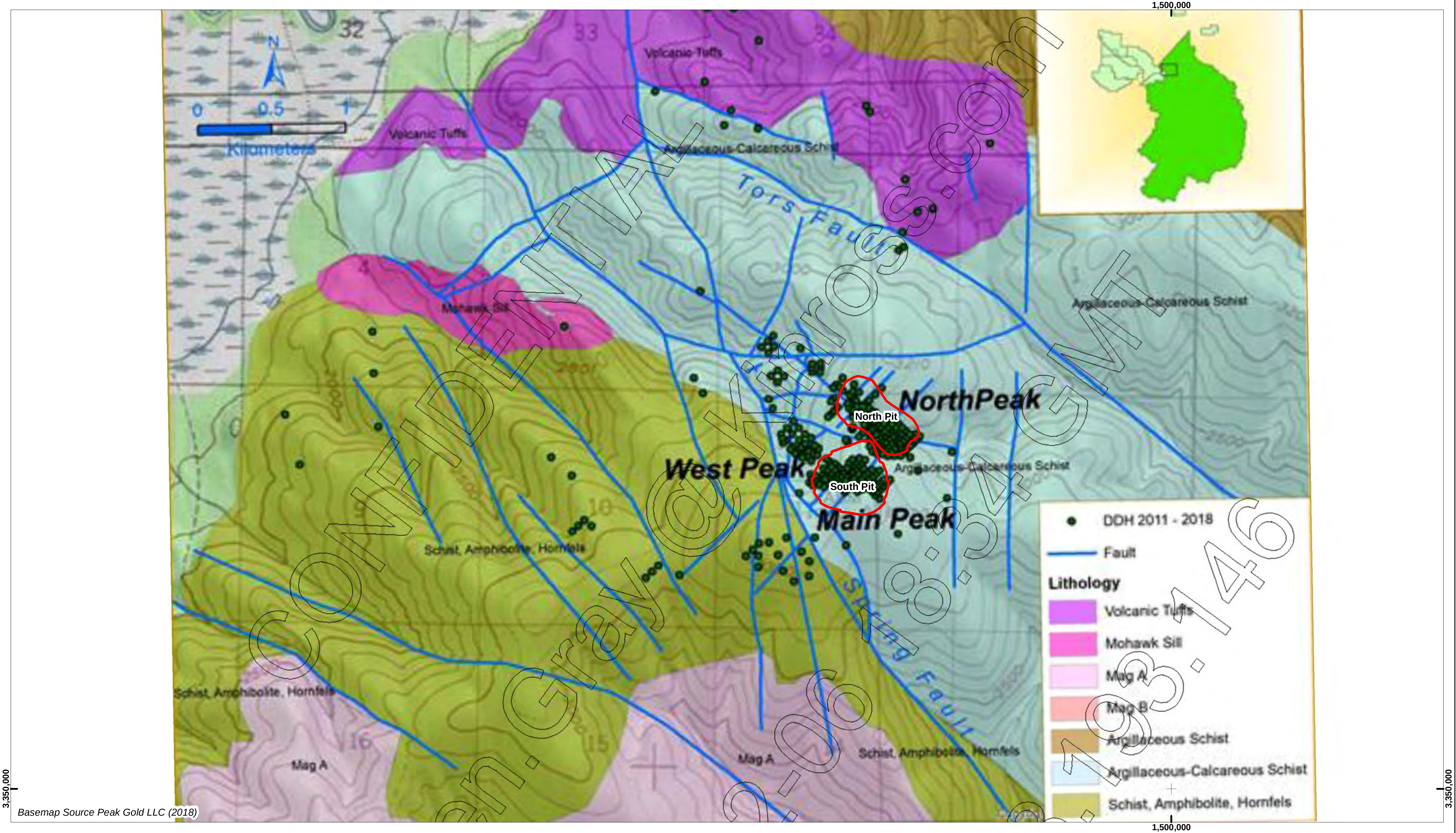
The majority of the bedrock in the area is a quartz muscovite ± biotite schist unit (QMS) containing conformable layers of amphibolite schist / greenstone. The QMS unit is primarily comprised of quartz, muscovite, biotite and local garnet with minor actinolite and epidote. QMS is fine to medium grained and varies in color from gray to green, green-gray or blue-gray with opaque to milky white quartz. This unit is usually tan to dark brown in the weathering zone.

The muscovite and biotite contents of the QMS unit are variable, with zones several meters thick containing only the muscovite-rich end member to zones a few centimeters thick containing only the biotite end member. Dodecahedral red garnets (almandine) within the QMS unit range in size from 0.08 in to nearly 0.4 in diameter.

2.1.2 Mineralization

Gold-sulfide mineralization is preferentially hosted in the calcareous schist units which are interbedded with the QMS unit and have been altered to amphibole – chlorite skarn. Because calcareous schists are less competent than surrounding QMS, calcareous rocks tend to deform more easily, resulting in their displaying a myriad of complex to simple deformational textures, including structural thickening and thinning, isoclinal and recumbent folding, cascade folding and disharmonic folding. This behavior often makes correlation of calcareous schist units, both barren and mineralized, difficult or impossible in drill sections. Age dating of the Manh Choh South alteration and mineralization indicates it is contemporaneous with Tertiary intrusive and volcanic activity.

Layers of massive, equigranular greenstone / amphibolite schist ranging from 5 ft to 49 ft thick are located on the south side of the prospect. This unit is weakly to moderately foliated with minor calcite and trace to minor disseminated pyrrhotite + chalcopyrite. Greenstone is often interbedded with quartz-mica schist and/or calcareous schist.



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DRAWING TITLE:
GEOCHEMICAL CHARACTERIZATION REPORT
LITHOLOGY

DATE: 9/15/2022
REVISION: B
SRK PROJECT NO.: 503000.070-0600
DRAWING NO.: FIGURE 2-1

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Petrographic observations detailed the presence of calcite, dolomite, and minor siderite in Peak Zone thin sections (Deininger 2013a,b). Carbonate, in general, was noted to range from 2% to 25%. Substantial but seemingly isolated siderite occurrence was noted at approximately 10% and 15% abundance in thin sections from TET1105 (Fault Zone) and TET1218 (QMS), respectively. Sulfides were observed to be predominantly comprised of pyrrhotite with lesser pyrite, chalcopyrite, sphalerite, arsenopyrite, bornite and trace covellite. Total sulfide abundance was estimated to range from 15% to 70%, depending on the degree of mineralization.

Manh Choh South is a largely distal skarn hosted in recumbent folded calcareous schist and marble interbedded with amphibolite grade argillaceous schist and quartzite. Gold, silver, and copper mineralization is associated with pyrrhotite-chalcopyrite-arsenopyrite dominant strata bound replacement bodies interlayered with Ca-Fe amphibole dominant gangue which has replaced the calcareous portions of the interlayered calc-schist units. Manh Choh North is a largely distal skarn hosted in recumbent folded calcareous schist and marble interbedded with amphibolite grade argillaceous schist and quartzite.

2.1.3 Oxidation

Natural oxidation has occurred due to weathering processes and has been preserved as a result of the lack of regional glaciation in this part of Alaska.

A significant portion of the Manh Choh North resource area is oxidized to depths in excess of 50 m below surface, resulting in widespread iron, copper and arsenic oxides. This strong, pervasive oxidation destroyed the magnetic and conductive pyrrhotite-arsenopyrite-chalcopyrite skarn mineralization, resulting in geophysical signatures unlike those over the unoxidized Manh Choh South zone. The weathering product of this mineralization, dominated by hematite, limonite, goethite, and scorodite-rich clays, make up a significant portion of the South-eastern portion of the Manh Choh North resource area.

2.1.4 Deposit Type

Exploration results revealed the presence of a distinctive suite of elements, sulfide minerals and alteration minerals at Manh Choh South and Manh Choh North that do not match the typical characteristics of an intrusive-related gold system but do share several diagnostic characteristics of distal reduced gold-copper-silver skarns and the larger porphyry copper systems with which such skarns are sometimes associated. The most pervasive and often abundant alteration assemblage associated with gold-sulfide mineralization is amphibole and chlorite, a mineral assemblage normally associated with retrograde skarn alteration.

Stilltoe (2013) suggested that the gold-rich mineralization at the Peak zone was part of a reduced gold skarn system within a larger porphyry copper setting, most closely resembling the gold-sulfide skarn deposits mined at the Fortitude deposit in the Battle Mountain Mining District of central Nevada.

2.2 Mine Plan

2.2.1 Mining Sequence and Waste Rock Management

Manh Choh South Pit and Manh Choh North Pit will be mined using open-pit methods incorporating conventional truck and shovel mining methods. Mining of the deposits will produce a total of approximately 5.1 Mt of processing plant feed and 49.7 Mt of waste over the 4.5-year mine life. Pit sequencing has been designed so that backfilling is optimized. Both pits will be mined concurrently.

The current mine plan uses a combination of pit backfilling and waste rock dumps for waste rock disposal:

- PAG rock with a low degree of oxidation is preferentially disposed underwater by backfilling below the eventual water level in the open pits (referred to as “wet disposal”) which will reduce contact with oxygen due to its low solubility in water.
- Oxidized rock with metal leaching potential (either PAG or non-acid generating (NAG)) will be disposed above the final water level as backfill and capped to limit water contact by infiltration (referred to as “dry disposal”).
- PAG waste rock which cannot be accommodated in wet disposal will be managed under dry conditions thereby limiting leaching of oxidation products.

Waste with lower potential for ML and/or ARD will be placed in ex-pit dumps with capture systems for contact waters. North Pit would be completed first and within the first 2 years of the mine life. South Pit will be mined for the 4.5-year duration, with backfilling of “dry disposal” rock directly into North Pit opportunistically. As mining progresses, the balance of “dry disposal” waste and all of the “wet disposal” waste will be stockpiled, then rehandled and placed into North Pit and South Pit, respectively, at closure. Two permanent waste rock dumps (WRD) will accommodate the material which cannot be backfilled (North WRD and Main WRD).

2.2.2 Ore Processing

Manh Choh ore will be transported to the Fort Knox Mine for processing. Tailings at Fort Knox are currently NAG and Kinross has explored the following three options for co-processing Manh Choh and Fort Knox ore:

1. 100% Manh Choh ore not blended with Fort Knox ore.
2. 20% Manh Choh ore blended with 80% Fort Knox ore.
3. 30% Manh Choh ore blended with 70% Fort Knox ore.

Kinross is currently proceeding with the option of batch processing Manh Choh ore separately to Fort Knox ore so no blending will be undertaken. Manh Choh and Fort Knox tailings will be stored separately. The current plan is to deposit the tailings from Manh Choh at the bottom of the Fort Knox pit and the tailings for Fort Knox will continue to be deposited within the existing tailings storage facility at Fort Knox. However, Kinross may consider also depositing some of the Fort Knox tailings at the bottom of the pit towards the end of the mine life.

Section 2.2.5 of the Fort Knox Waste Management Permit (2020DB0002) specifies a number of conditions which must be satisfied to enable processing and disposal of ore from satellite pits at Fort Knox, including:

- A comparison of the new ore chemistry with currently mined Fort Knox ore.
- A MWMP to be conducted on the mixed ore samples prior to beneficiation.
- An acid base accounting (ABA) test to be conducted on mixed ore samples prior to beneficiation and humidity cell test (HCT) if Neutralization Potential (NP) / Acid Potential (AP) ratio is less than 3:1.
- A characterization of the processed tailings liquor, post cyanide detoxification.
- A MWMP to be conducted on the tailings solids post cyanide detoxification.

2.3 Previous Geochemical Studies

SRK has previously completed three phases of Geochemical Characterization for the Manh Choh Project (SRK 2013, SRK 2018, SRK 2019). In historical reports South Pit is formerly known as "Main Peak" and North Pit is formerly known as "North Peak". Key conclusions from these studies are summarized below:

- 25% of South Pit samples analyzed were previously classified as PAG using the Neutralization Potential (NP) / Acid Potential (AP) ratio criteria of less than one indicating PAG[1]. 31% of South Pit samples were classified as uncertain (1<NP/AP≤3).
- In comparison 15% of North Pit samples were classified as PAG and 24% were classified as uncertain by the same criteria[1].
- Average trace element content was generally higher in the South Pit deposit than the North Pit deposit.
- Inductively coupled plasma atomic emission spectroscopy (ICP-AES) sulfur in the exploration database may be used as a surrogate for AP. No suitable surrogate for NP is available.
- ARD potential is low from surface to approximately 40 m depth in the South Pit deposit due to low sulfur content. In the North Pit deposit PAG samples were observed throughout including samples close to surface.
- Two tailings samples were historically analyzed from South Pit and North Pit (SRK, 2019). Sulfide concentrations in these tailings ranged from 0.12% for the North Pit sample to 6.04% for the South Pit sample. The North Pit tailings sample was classified as NAG. The South Pit sample was classified as PAG (NP/AP less than 1 and ICP S greater than 0.01%).
- A MWMP was undertaken on the tailings and the leachates were typically circumneutral. Concentrations of arsenic, cobalt, and molybdenum in the MWMP leachate from both tailings samples exceeded the most stringent water quality guidelines. Antimony and selenium concentrations in the leachate generated from the South Pit sample also exceeded the strictest water quality guidelines.

Humidity cell data were previously reported by SRK (2020a). This study presents updates on all humidity cell testwork to date (Section 5.1.6).

2.4 Exploration Geochemical Database

SRK was provided with the drillcore database which includes drillhole data primarily from exploration drilling but also from the 2020/2021 metallurgical and geotechnical drilling programs. As of December 2021, the database consists of 528 drillholes with multi-element analysis data for 56,059 sample intervals of which all were analyzed for sulfur content. The sample intervals are continuous downhole, determined on the basis of changes in lithology and/or degree of alteration. Samples were analyzed by four-acid digest followed by inductively coupled plasma atomic emission spectroscopy (ICP-AES) at either ALS Minerals, ACME Laboratories or Bureau Veritas Laboratories.

The exploration database was reviewed as part of the sample selection process in previous geochemical characterization studies (SRK 2013, SRK 2018). The database was used to determine the main lithologies, relative proportions of each lithology and chemical compositions associated with

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[1] In historical studies the following NP/AP criteria has been used:

- NP/AP greater than 3 indicates negligible potential for ARD.
- NP/AP less than 1 indicates the material has potential to generate ARD.
- NP/AP between 1 and 3 indicates rock with uncertain ARD potential.

the Manh Choh deposit. Ore cut-off grades of gold >0.5 ppm, silver >10 ppm and copper >1,000 ppm were used in SRK (2018) to target waste materials.

SRK recommended adding direct carbonate analysis (using $HClO_4$ digestion followed by CO_2 analysis by colorimeter) to the exploration data suite for all samples tested during the 2020 and 2021 geotechnical and infill drilling programs (SRK 2020b). The recommendation was made to assist Peak LLC in refining PAG volume estimations within the existing block model after it was determined that calcium analyzed by four-acid digestion and ICP-AES was not an appropriate surrogate for NP.

As of December 2021, a total of 3,160 samples in the exploration database had carbonate data reported. All samples analyzed for carbonate also have sulfur concentrations obtained by ICP.

3 Study Design

3.1 Conceptual Geochemical Model

A conceptual geochemical model was developed to guide the design of this characterization program. This has been based on historical geochemical characterization work together with an understanding of geological and mineralogical features as described in Section 2.1.

3.1.1 Waste Rock

Historic studies show that there is potential for ML/ARD at both Manh Choh South and Manh Choh North deposits and differences in weathering states between the two deposits will likely influence that potential. ARD is a function of the coupled processes of iron sulfide oxidation to generate acid, and neutralization of the resulting acidity by carbonate minerals. The tendency for ARD to actually form depends on the balance between the amounts of sulfide minerals and carbonates, and the disposal conditions. If amounts of sulfide minerals exceed the carbonate minerals, ARD may develop at some future time if the disposal conditions allow the sulfide minerals to oxidize readily. ML refers to general processes of leaching of rock components (which include metals and other regulated elements and ions) into contact waters at levels that could result in a concern for receiving waters if not managed appropriately. All rocks and the related mines wastes contain regulated substances but the abundance and mineralogical occurrence of them ultimately determines whether leaching processes are significant.

Manh Choh South deposit is largely unoxidized. Average metal content is typically higher than in Manh Choh North but sulfur content is generally low down to around 40 m depth which results in a low ARD potential at shallow depths. The likelihood of ARD generation increases with depth; SRK (2018) reported the occurrence of PAG or material with uncertain acid generation potential predominantly at depths greater than 130 ft. Sulfide sulfur concentrations are highest in the skarn material at around 325 to 490 ft depth. No trend was observed for carbonates. North Pit is mainly oxidized down to depths in excess of 165 ft below surface and although there are likely to be lower volumes of PAG waste within North Pit, it appears more variable with depth and lower carbonate content was typically observed to approximately 165 ft depth (SRK, 2018). North Pit deposit contains widespread iron, copper and arsenic oxides and it is possible that the oxidized materials are susceptible to flushing soluble minerals if in contact with meteoric waters. Oxidized waste rock may be more likely to generate an immediate short-term flush whereas unoxidized waste rock could have more potential for longer-term leaching. The delay to onset of PAG conditions is an important consideration, particularly for post-closure activities.

A number of elements are enriched within both deposits and hence pose a risk for metal leaching; notably arsenic, cadmium, cobalt, copper, lead, selenium, and silver. Management of PAG waste will help control the metal leaching potential of pH sensitive parameters however there is still potential for neutral metal leaching, particularly for arsenic and antimony.

Waste rock segregation will be important in managing PAG waste so it is important to refine the material domaining as much as possible. The scale of variability within the waste rock will influence the feasibility of waste rock segregation and water quality predictions will need to include a factor which accounts for misclassification of materials.

3.1.2 Open Pit

Open pit mining will leave waste rock exposed within the pit walls with the same characteristics as described in Section 3.1.1. Any waters contacting these materials have the potential to influence the overall water chemistry.

In North Pit, pit walls will be exposed for a maximum of five years after which time the pit will be completely backfilled. South Pit walls will be exposed for a similar length of time until the pit is partially backfilled.

The delay to onset of acidic conditions is an important consideration which is explored through the laboratory kinetic humidity cell tests and may be further refined with the on-site kinetic barrel tests as sufficient data become available. The current predictions of timing to the onset of acidic conditions are presented in Section 6.1.5.

3.1.3 Construction Materials

Conceptually, near surface oxidized material could be more suitable for construction if weathering and leaching processes have fully depleted reactive minerals, though the residual material may contain readily leachable oxidation products resulting in poor quality contact water. This study considered test pit samples along the road alignment which were identified as suitable for use in construction (Section 5.3). In addition, Section 6 presents the waste classification criteria which can be used to identify materials with a low potential for acid generation and metal leaching that would also be suitable for use in construction.

3.1.4 Ore Stockpile

The ore stockpile poses a potential for ML/ARD; a comparison of the exploration database between ore and waste indicates ore has statistically higher arsenic and sulfur content when compared to waste (SRK, 2021a). The weathering behavior of ore materials from South Pit and North Pit are being investigated as part of the onsite kinetic barrel tests. Once available, this data will contribute to source term generation for the ore stockpiles. Short-term static test results are available for the proposed ore materials and laboratory kinetic humidity cell tests were initiated in February 2022; results are presented in Section 5.2.

3.1.5 Tailings

Historical testing of tailings samples from South Pit and North Pit indicate that the oxidized South Pit tailings are likely to be PAG due to elevated sulfide content whereas low sulfide oxidized North Pit tailings are NAG. Both samples reported elevated concentrations of arsenic, cobalt and molybdenum and South Pit tailings also reported elevated antimony and selenium.

The existing Fort Knox tailings are NAG and Kinross has explored co-processing options on variable blends of Manh Choh and Fort Knox ore but is currently pursuing the option of batch processing Manh Choh ore separately without any blending. Manh Choh ore will be deposited separately to Fort Knox ore, but testing is required to understand the potential contribution of solutes in the Manh Choh tailings and increased leachate load within the process waters. Test work has been undertaken on several detoxified tailings samples including a Manh Choh Master Composite plus different blends of Manh Choh and Fort Knox materials. The results are presented in Section 5.2.

3.2 Gap Review

SRK understands regulatory approval for the project will be provided through the State of Alaska. The State does not have specific guidance on the execution of geochemical characterization projects in support of mining projects except in the case of tailings. SRK has therefore relied on experience and precedents in the State to design the overall geochemical characterization program.

The following tasks were identified to advance the project:

- **Block Model**. To understand the distribution of bulk characteristics that can be linked to weathering behavior so that disposal can be optimized to minimize leaching of material characteristics:
    - The model aims to identify linkages between bulk geochemical characteristics such as sulfide content, acid rock drainage potential and arsenic content, to weathering characteristics.
    - Site specific waste geochemical parameters were needed to populate the model.
- **Waste Segregation Criteria**. Needed to define PAG vs NAG materials, delay to onset of ARD for PAG materials, definition of ML potential for NAG materials, and identification of short- vs long-term leaching materials (i.e., the influence of oxidation). Developed through interpretation of the linkage between bulk characteristics and weathering behavior.
- **Waste Segregation Feasibility**. To test the theory of waste segregation and ensure it is achievable at mining scale.
- **Source Water Chemistry Predictions**. To predict the concentrations of waters directly in contact with mined surfaces (e.g., waste rock dumps and stockpiles, pit walls, effect of flushing oxidized materials during pit flooding).
- **Influence of Manh Choh Tailings at Fort Knox**. To understand the characteristics of the Manh Choh tailings and how these will influence water chemistry.

3.3 Characterization Program Design

The following additional characterization was undertaken to fill gaps in the previous dataset in support of the above tasks:

- Sampling of 2020/2021 drillcore to include carbonate data.
- Additional laboratory kinetic humidity cell tests (HCTs).
- Mineralogical analysis.
- Short term leaching tests: sequential meteoric water mobility procedure (SMWMP) (in progress).
- Kinetic on-site barrel tests (in progress).

Full details of the study design components are summarized in Table 3-1.

Table 3-1: Study Design Components

	Geochemical Consideration	Requirements	Methods
Waste Rock Characterization	Site-specific application of ML/ARD potential methods	ML and ARD characteristics of each material type representing majority of waste rock tonnages	Drillcore sampling (specific sample intervals and full downhole)
			Static testing (ABA and multi-element analysis)
		Correlation of ABA and multi-element data	Lithological block model and waste scheduling
		Occurrences of minerals (types, crystal form, occurrence)	Mineralogical analysis QEMSCAN, petrography
		Mineralogical occurrence of critical contaminants	
		Mineralogy of carbonates as well as Ca, Mg and Fe content needs to be determined to allow refinement of block model NP	
	Development of ML/ARD criteria	Rate of depletion of sulfides and acid neutralizing minerals and correlation with bulk characteristics	Kinetic testing – laboratory humidity cells and field barrels
	Site specific NP and AP equations	Rate of release of contaminants and correlation with bulk characteristics	Field weathering observations of analogues and field barrels, SMWMP
	Variability in characteristics of wastes:	Chemical composition of waste rock	Drillcore sampling (specific sample intervals and full downhole)
	·Waste distribution	Spatial variation of ML and ARD and metal leaching non-ARD	Static testing (ABA and multi-element analysis)
	·Release schedules	Rate of release of contaminants and correlation with bulk characteristics	Lithological block model (including geochemical parameters) and waste scheduling
	·Segregation of wastes		
	Chemistry of seepage and runoff for non-acidic and acidic conditions	Rate of release under non-acidic and acidic conditions	Kinetic testing – laboratory (humidity cells) and field (barrels)
		Solubility controls	Observations of analogues, SMWMP, field barrels
		Site water quality database to calibrate water chemistry estimated from laboratory tests	Natural seep sampling, water quality monitoring database
		Water balance for waste rock	Hydrological evaluations
		Water chemistry prediction (source term)	Predictive numerical calculations (modelling)
	Effect of blasting on ARD potential	Occurrences of minerals (types, crystal form, occurrence)	Geological review Optical mineralogy
		ABA in range of particle sizes	Operational monitoring – sampling of waste rock material as mining commences (i.e., when waste rock material is generated)
	Particle size effects		Static testing (ABA and multi-element analysis) on size fractions
Pit Wall Characterization	Variability in characteristics of pit walls	Lithological composition of pit walls as mine proceeds and during closure	Geological model and mine plan
		Mineralogical and geochemical characteristics of waste units exposed in pit walls	See waste rock program
		Contaminant release rates for non-acidic and acidic conditions	
	Chemistry of runoff and pit water for non-acidic and acidic conditions	Water chemistry prediction (source term)	Predictive numerical calculations (modelling)
Construction Material	Site-specific application of ML and ARD potential methods	ML and ARD characteristics for various material sources	Static testing (ABA, multi-element and MWMP)
		Occurrences of minerals (types, crystal form, occurrence)	
	Variability in characteristics	Lithological and chemical composition of material sources	
	Chemistry of runoff	Water chemistry prediction (source term)	Predictive numerical calculations (modelling)
Tailings Characterization	Variability of characteristics by ore feed	ML and ARD characteristics	Static testing (ABA, multi-element, MWMP)
		Occurrences of minerals (types, crystal form, occurrence)	Mineralogical analysis QEMSCAN, petrography
	Effect of Peak tailings on Fort Knox Water Quality	Rate of depletion of sulfides and acid neutralizing minerals and correlation with bulk characteristics	Potential kinetic testing (laboratory humidity cells)
		Water chemistry prediction (source term)	Predictive numerical calculations (modelling)
Ore Stockpiles	Site-specific application of ML and ARD potential methods	ML and ARD characteristics	Static testing (ABA, multi-element)
		Occurrences of minerals (types, crystal form, occurrence)	Mineralogical analysis QEMSCAN, petrography
	Site specific NP and AP equations	Rate of depletion of sulfides and acid neutralizing minerals and correlation with bulk characteristics	Kinetic testing (laboratory humidity cells)
	Site specific metal leaching characteristics	Rate of release of contaminants and correlation with bulk characteristics	
	Chemistry of seepage and runoff from ore stockpiles	Water chemistry prediction (source term)	Predictive numerical calculations (modelling)

Source: https://srk.sharepoint.com/sites/NA503000.040/Deliverables/080_Deliverables/05.GeochemProgramSummary/[GeochemCharacterization_SummaryTable_503000.040_ld_rev00.xlsx]

4 Characterization Methods

4.1 Sample Acquisition

4.1.1 Waste Rock

Static Testwork

To supplement the exploration database of sulfur and carbonate analysis (see Section 2.4), static test-work has been undertaken on 96 waste rock samples from South Pit and North Pit deposits since 2013. The majority of these static samples were analyzed through the historic testwork programs, summarized as follows:

- South Pit:
  - 51 samples were analyzed as part of the Phase I and Phase II programs (SRK 2013, SRK 2018)
  - 5 samples were analyzed as part of the Phase III program (SRK 2019)
  - 3 samples were analyzed as part of the 2021 characterization program.
- North Pit:
  - 33 samples were analyzed as part of the Phase I and Phase II programs (SRK 2013, SRK 2018)
  - 4 samples were analyzed as part of the 2021 characterization program.

The seven new samples analyzed as part of the 2021 study were selected as additional kinetic humidity cells on the Project. The rationale for the humidity cell selection is described below. Table 4-1 presents a summary of all waste rock samples by lithology.

Table 4-1: Summary of Static Waste Rock Samples

Material Type	Deposit	No. of Samples
Calc-Schist	South Pit	2
	North Pit	4
QMS	South Pit	34
	North Pit	14
Skarn	South Pit	23
	North Pit	19
Total		**96**

Source: https://srk.sharepoint.com/sites/NA503000.040/Internal/050_Databases/[Tetlin_StaticDatabase_481900.030_ld_je_ab_rev10.xlsx]

Laboratory Kinetic Humidity Cell Tests

Two phases of humidity cell testing have been initiated on the project. An initial eleven humidity cells were commissioned in May 2019, consisting of nine waste rock samples, one duplicate and one blank cell. The selection rationale for these samples is presented in SRK (2019) and a sample summary is provided in Table 4-2. Three of these humidity cells were completed at Week 101, a further three plus the duplicate and blank cell were completed at Week 142, and three cells are currently continuing. Results for these ongoing humidity cells are reported to Week 161.

Table 4-2: 2021 Humidity Cell Sample Selection

Humidity Cell ID	Redox Classification	Hole ID	From (m)	To (m)	Lithology	Area	Sample Selection Rational	Status
Tetlin HC-1	Sulfide	TET16304	88	90	Skarn	North Pit	P50 sulfide, low TIC	Reported to Week 161
Tetlin HC-2	Sulfide	TET12057	110.64	116.13	Skarn	South Pit	P95 sulfide, higher TIC	Completed at Week 101
Tetlin HC-3	Sulfide	TET12037	109	111	Skarn	South Pit	P95 sulfide, higher TIC	Completed at Week 142
Tetlin HC-4	Sulfide	TET12061	104.24	110.34	Skarn	South Pit	P50 sulfide, low TIC	Completed at Week 101
Tetlin HC-5	Oxide	TET12044	31.85	36.27	QMS	South Pit	Low TIC, P95 sulfide	Reported to Week 161
Tetlin HC-6	Sulfide	TET12043	101.8	103.78	QMS	South Pit	Higher TIC, P50 sulfide	Completed at Week 101
Tetlin HC-7	Sulfide	TET16267	102	105	QMS	South Pit	Only two samples available, selected higher sulfide	Completed at Week 142
Tetlin HC-8	Sulfide	TET16208	50	51	QMS	South Pit	Only sample available	Completed at Week 142
Tetlin HC-9	Oxide	TET16239	83.1	88.9	QMS	North Pit	Only two samples available, selected higher sulfide	Completed at Week 142
Manh Choh HC-1	Oxide	TET16285	42.6	46.5	Skarn	North Pit	Primary target P50 As/S mol ratio	Completed at Week 40
Manh Choh HC-2	Oxide	TET17345	3.66	4.71	Skarn	North Pit	Primary target P95 As/S mol ratio	Lab parameters reported to Week 62, other data to Week 60
Manh Choh HC-3	Oxide	TET13078	53.735	55.93	Skarn	South Pit	Primary target P75 As/S mol ratio	Completed at Week 40
Manh Choh HC-4	Oxide	TET17348	21.95	23.24	Calc-Schist	North Pit	Primary target P50 As/S mol ratio	Completed at Week 40
Manh Choh HC-5	Oxide	TET20456	41.18	46.18	QMS	South Pit	Primary target P75 As/S mol ratio	Completed at Week 40
Manh Choh HC-6	Sulfide	TET20458	72.84	73.99	Calc-Schist	North Pit	Primary target P75 As/S mol ratio	Completed at Week 40
Manh Choh HC-7	Sulfide	TET20452	81.37	82.91	Skarn	South Pit	Primary target P50 As/S mol ratio	Lab parameters reported to Week 62, other data to Week 60
--	sulfide	TET20450	43.58	44.89	Skarn	South Pit	Primary target P95 As/S mol ratio	Commencing November 2022
--	sulfide	TET21473	107.71	111.88	QMS	North Pit	Primary Target P50 As/S mol ratio	Commencing November 2022
--	Oxide	TET21482	4.38	7.89	QMS	North Pit	Primary Target P50 As/S mol ratio	Commencing November 2022
--	Oxide	Barrel 1			QMS	North Pit	Refer to Barrel Sample Selection (Table 4-3)	Commencing November 2022
--	Oxide	Barrel 2			Skarn	North Pit	Refer to Barrel Sample Selection (Table 4-3)	Commencing November 2022
--	Oxide	Barrel 3			QMS	South Pit	Refer to Barrel Sample Selection (Table 4-3)	Commencing November 2022
--	Sulfide	Barrel 4			QMS	South Pit	Refer to Barrel Sample Selection (Table 4-3)	Commencing November 2022
--	Sulfide	Barrel 5			Skarn	South Pit	Refer to Barrel Sample Selection (Table 4-3)	Commencing November 2022
--	Sulfide	Barrel 6			QMS	North Pit	Refer to Barrel Sample Selection (Table 4-3)	Commencing November 2022
--	Sulfide	Barrel 7			Skarn	North Pit	Refer to Barrel Sample Selection (Table 4-3)	Commencing November 2022
--	Sulfide	Barrel 8			Calc Schist	North Pit	Refer to Barrel Sample Selection (Table 4-3)	Commencing November 2022
--	Sulfide	Barrel 4 DUP			QMS	South Pit	Barrel 4 Duplicate	Commencing November 2022

Source: https://srk.sharepoint.com/sites/NA503000.040/Internal/050_Databases/[Tetlin_StaticDatabase_481900.030_ld_je_ab_rev10.xlsx]

A further nine humidity cells were commissioned in May 2021, consisting of seven waste rock samples, one duplicate and one blank cell. Details of these humidity cells are summarized in Table 4-2. Five waste rock cells were completed at Week 40 and results are reported to Week 62 for the remaining two plus the duplicate and blank cells. At the time of writing three additional humidity cells have also been selected, sample preparation is currently underway and the cells are due to commence imminently, these samples are included in Table 4-2 for completeness.

The 2021 humidity cell samples were selected following an HCT Gap Analysis (SRK, 2021a). The aim was to ensure that there was sufficient sample representation to support the baseline geochemical characterization requirements and develop source terms to support water quality modeling. The 2021 sample selection focused on targeting specific interval gaps for oxide or sulfide materials with consideration given to varying As/S mol ratios. Arsenic leaching is controlled by the mineralogical host of arsenic which can include arsenian pyrite, arsenopyrite and iron oxyhydroxides. Arsenic dominantly hosted in arsenopyrite will leach at higher concentrations when compared to arsenic hosted in pyrite and iron oxyhydroxides because iron in the pyrite and oxyhydroxides sequesters arsenic more effectively than iron in arsenopyrite.

The molar ratio of As/S was calculated as a proxy for arsenic metal leaching where a ratio of <0.1 mol/mol indicates the dominant sulfide mineral for arsenic is probably pyrite and a ratio of >0.1 mol/mol indicates a sample is more likely to contain arsenopyrite. Review of the database showed that variability in As/S increased as the ratio increased above 0.1 mol/mol. For oxide material, molar ratio of 1 mol/mol was used to represent the possible presence of arsenic associated with iron oxides.

Onsite Kinetic Barrel Tests

Eight material types were selected for onsite kinetic barrel tests to assess the effects of site conditions and scale on mine waste leaching behavior. The criteria used in the material selection was:

- Location (South Pit or North Pit)
- Lithology
- Redox classification (oxide or sulfide material) by the sulfide model surface
- Ore or waste
- Sulfur content
- Arsenic content
- Arsenic / sulfur molar ratio

Table 4-3 summarizes the barrel sample selections. In some instances, it was not possible to entirely fulfil the initial target criteria due to material availability and/or poor core recovery so the target criteria was expanded. Two samples were selected for sequential meteoric water mobility procedures (SMWMPs) where there was not enough material to conduct field barrel testing. These samples are also included in Table 4-3. The barrels were initiated in July 2022 and leachate sampling will be undertaken on a monthly basis when there is sufficient water available for analysis.

Table 4-3: Summary of Onsite Kinetic Barrel Test Materials

Barrel #	Pit	Litho	Oxide/Sulfide	Ore/Waste	Target Criteria‡
1	North	QMS	Oxide	Waste	P75 to P95 sulfur, arsenic >1 As/S mol ratio (arsenic associated with iron oxides) Sulfur content >0.01% to evaluate acid generation at low sulfur and low carbonate content
2	North	Skarn	Oxide	Waste	Sulfur = 0.01% P62 to P97 arsenic >1 As/S mol ratio (arsenic associated with iron oxides)
3	South	QMS	Oxide	Waste	Sulfur = 0.01-0.03% P40 to P95 arsenic Other criteria limited by material availability
4	South	QMS	Sulfide	Waste	As/S mol ratio <1 (to avoid iron oxides) ICP Sulfur>=0.03% Arsenic P55 to P90
5	South	Skarn	Sulfide	Ore	As/S mol ratio <1 (to avoid iron oxides) Arsenic P50 to P95, criteria expanded to produce enough material for barrel due to poor recovery
6	North	QMS	Sulfide	Waste	As/S mol ratio <1 (to avoid iron oxides) Arsenic P30 to P98, expanded criteria to produce enough material for barrel due to poor recovery Sulfur >0.01%
7	North	Skarn	Sulfide	Ore	Had to select all intersections from the 2020/2021 drilling to produce enough material for barrel
8	North	Calc Schist	Sulfide	Waste	S >0.01% Arsenic P21 to P100, expanded criteria to produce enough material for barrel Other criteria limited by material availability
9	South	Skarn	Sulfide	Ore	Duplicate of Barrel 05
SMWMP2*	North	Calc Schist	Oxide	Waste	Barrel not required, selected sample for SMWMP
SMWMP3*	South	Skarn	Oxide	Waste	Sulfur = 0.01% Arsenic P75 >1 As/S mol ratio

Source: https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 220 Barrel Test/[BarrelTest_SampleSelect_503000.040_ld_mc_rev09.xlsx]
*SMWMP tests proposed where barrel testing was not required or where insufficient material was available to fulfill onsite kinetic barrel testing.
‡ Target criteria could not be entirely fulfilled in all cases due to low core recovery and limited material availability.

4.1.2 Ore and Tailings

Kinross has explored the following three options for co-processing Manh Choh and Fort Knox ore:

1. 100% Manh Choh ore not blended with Fort Knox ore.
2. 20% Manh Choh ore blended with 80% Fort Knox ore.
3. 30% Manh Choh ore blended with 70% Fort Knox ore.

Static Testwork

Ore and tailings samples are summarized in Table 4-4.

Three raw ore samples (before beneficiation), generated according to the three blend options, were submitted for static geochemical testing. The samples subsequently underwent metallurgical testing and the detoxified barren solutions and solids after cyanide leaching / cyanide detoxification were also submitted for static geochemical testing

The samples designated as “O_2” tests were sparged with oxygen during the leaching process and the samples designated as “Air” tests were sparged with air during leaching the leaching process.

Kinross is currently proceeding with the option of batch processing Manh Choh ore separately to Fort Knox ore so no blending will be undertaken and the two tailings streams will be deposited separately. Further metallurgical testwork was therefore undertaken in 2022 on the Manh Choh Master Composite only under refined processing test conditions. Table 4-5 provides a summary of the original and revised processing test conditions for background information.

Laboratory Kinetic Humidity Cell Tests

According to the conditions outlined in the Fort Knox Waste Management Permit (2020DB0002), the three raw ore samples were selected to undergo humidity cell testing. The cells were initiated in February 2022 and data are reported to Week 31 for laboratory parameters and Week 30 for all other data.

4.1.3 Construction Materials

A number of test pits were excavated by Shannon and Wilson, Inc. Fairbanks, Alaska as part of the geotechnical investigations for the project. Samples were collected from test pits in the region of the waste rock dumps, proposed road alignment and borrow pit sources.

Shannon and Wilson provided a list of test pit samples and a map of sample locations (Figure 4-1) from which SRK selected a subset of 24 samples for initial static geochemical tests. The sample selection focused on the area of the proposed road alignment and borrow pit sources because the waste rock dump areas will be covered. The samples were selected with the aim of maintaining good spatial representivity across the different test pits and ensuring that all material types were represented. A list of samples is provided in Table 4-5. TP20 is located at Material Source #6 which is designated for road construction materials. No geochemical characterization has been undertaken at TP20 but samples were analyzed from nearby TP19 and TP21.

Table 4-4: Summary of Ore and Tailings Samples and Status of Test Work

Sample Type	Samples:	Test Work Status
Ore before beneficiation	Manh Choh Master Composite	ABA, Multi-Element Analysis & MWMP with Profile II Analysis Complete. Humidity Cell Testing Ongoing
Ore before beneficiation	20% Manh Choh Master Composite + 80% Fort Knox Composite	
Ore before beneficiation	30% Manh Choh Master Composite + 70% Fort Knox Composite	
Detoxified barren solution	Manh Choh Master Composite (O_2)	Profile II Analysis Complete
Detoxified barren solution	20% Manh Choh Master Composite + 80% Fort Knox Composite (Air)	
Detoxified barren solution	30% Manh Choh Master Composite + 70% Fort Knox Composite (Air)	
Detoxified barren solution	30% Manh Choh Master Composite + 70% Fort Knox Composite (O_2)	
Tailings solids post cyanide detox	Manh Choh Master Composite (O_2)	ABA, Multi-Element Analysis & MWMP with Profile II Analysis Complete.
Tailings solids post cyanide detox	20% Manh Choh Master Composite + 80% Fort Knox Composite (Air)	
Tailings solids post cyanide detox	30% Manh Choh Master Composite + 70% Fort Knox Composite (Air)	
Tailings solids post cyanide detox	30% Manh Choh Master Composite + 70% Fort Knox Composite (O_2)	
Detoxified barren solution	Manh Choh Master Composite (updated process simulation testing conditions)	Profile II Analysis Complete
Tailings solids post cyanide detox	Manh Choh Master Composite (updated process simulation testing conditions)	ABA, Multi-Element Analysis & MWMP with Profile II Analysis Complete.

Source: https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 500 Tailings Characterization/[MetTestSummary 20220908.xlsx]Sample Summary

Table 4-5: Summary of Processing Simulation Conditions for Manh Choh Master Composite

Parameter	Previous Bulk Leach	2022 Updated Bulk Leach
Feed Size	80%-75µm	
Cement/Lime Additions, lb/ton	8.00/4.42	
Leaching Slurry Density	40% Solids	
Sparging gas	Oxygen	Air
Leach Time	24 hours	56 hours
CIP Carbon Addition	10 g/L at 14 hours	
NaCN Conc.	2.0 lbNaCN/ton maint. for 14 hr	1.0 lbNaCN/ton maint. for 14 hr
pH Target	10.5-11.0	
Ending Procedure	Remove carbon, thicken to 60% solids	Remove carbon, dilute to 30% solids, thicken to 60% solids
Detox Method	SO_2/air	

Source: J. Olsen, McClelland Laboratories, Inc, email communication (16 Jun 22)

4.2 Analytical Methods

The seven waste rock samples and twenty-four construction rock samples were shipped to Bureau Veritas Laboratory, Canada for chemical analysis.

The ore and tailings samples underwent analysis at ALS Laboratories, Vancouver, Canada, McClelland Laboratories, Sparks, Nevada, USA and WETLab, Sparks, Nevada, USA.

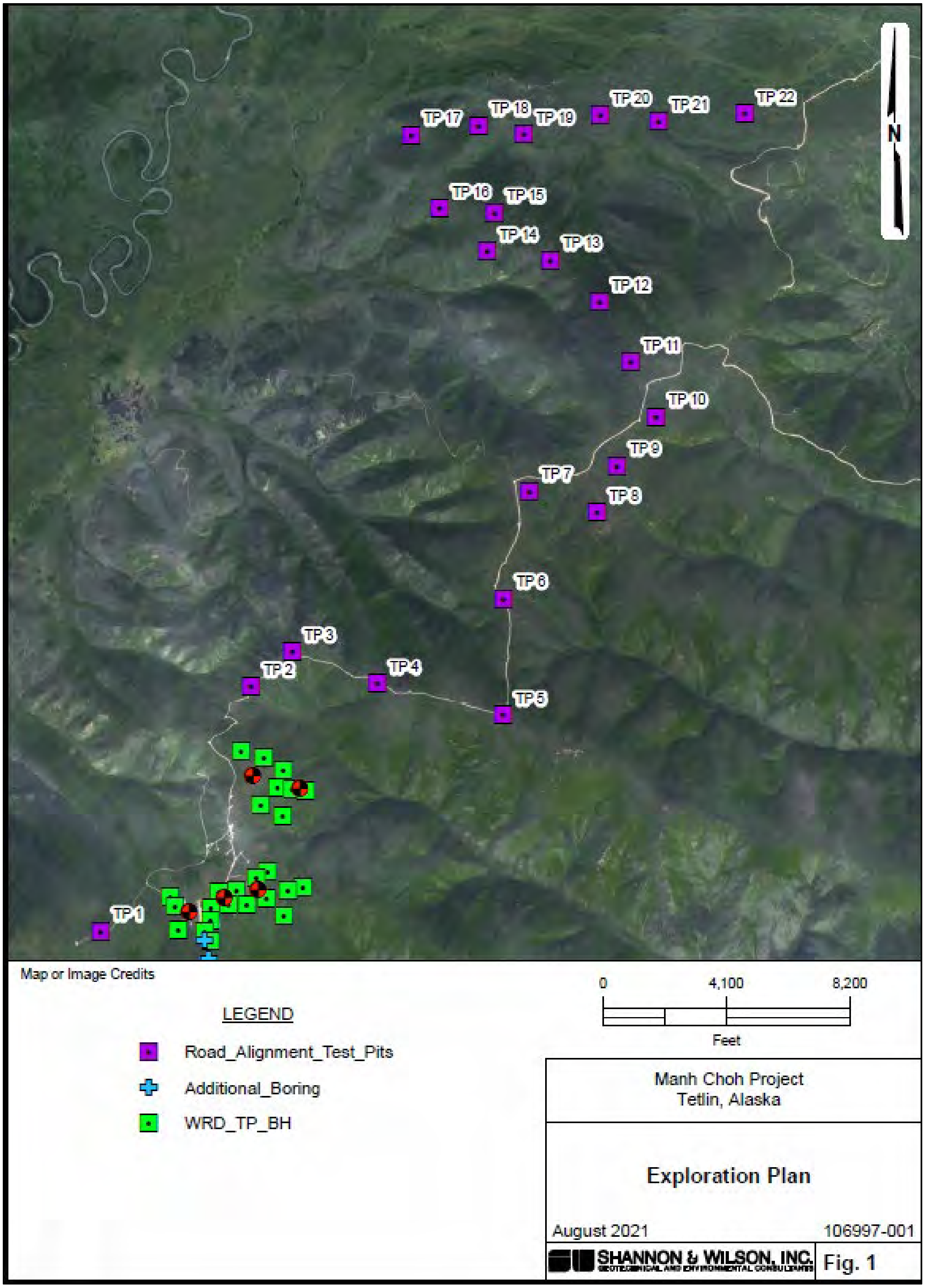
4.2.1 Sample Preparation

To prepare waste rock samples for static geochemical tests drillcore samples were initially crushed to -6.3 mm and representative sub-samples were obtained by split riffling followed by pulverizing to <100 µm. This ensures that a representative sub-sample is generated from the drillcore material collected.

MWMP tests are conducted on material with a particle size of less than 5 cm particle size, obtained through sieving.

Humidity cell testing is undertaken on crushed material screened to less than 6.3 mm.

Preparation of the ore samples was undertaken at McClelland, Laboratories, Sparks, Nevada, USA. The laboratory was provided with a pre-milled sample of Fort Knox ore. The Manh Choh Master Composite was milled to 80% passing -200 mesh and dried. The master composites were combined to produce two samples 20% Manh Choh to 80% Fort Knox and 30% Manh Choh to 70% Fort Knox. Split samples were generated for the MWMP tests and further splits were pulverized for the ABA and ICP analyses.



Source: W. Presler, Shannon & Wilson, 2021, personal communication, August 26

Figure 4-1: Test Pit Locations

Table 4-6: Summary of Construction Material Samples

Test Pit	Sample ID	Top Depth (feet)	USCS Soil/Rock Type
TP01	Rock Grab	1.0	Mica-Quartz-Schist
TP02	S-1	2.5	Quartz-Mica-Schist
TP02	S-2	2.5	Elastic Silt
TP02	S-3	7.8	Igneous
TP03	S-1	2.5	Andesite
TP05	S-1	0.5	Silty Gravel
TP05	S-2	2.5	Quartz-Mica-Schist
TP06	S-2	2.5	Quartz-Mica-Schist
TP07	S-2	3.5	Quartz-Mica-Schist
TP10	S-1	1.5	Quartz-Mica-Schist
TP12	S-1	2.5	Quartz-Mica-Schist
TP15	S-2	3.0	Mica-Quartz-Schist
TP19	S-1	1.0	Low plasticity silt
TP19	S-2	2.5	Silty Gravel
TP21	S-1	2.0	Poorly Graded Sand with Gravel
TP21	S-2	3.0	Poorly Graded Gravel with Sand
TP22	S-1	0.5	Silty Gravel
TP22	S-2	3.0	Poorly Graded Gravel with Sand
TP23	S-1	2.7	Low plasticity silt
TP23	S-2	4.0	Poorly Graded Sand with Silt and Gravel
TP23	S-4	14.0	Poorly Graded Gravel with Sand
GP01	S-1	Stockpile	Poorly Graded Gravel with Sand
GP03	S-1	Stockpile	Poorly Graded Gravel with Sand
BTP02	S-1	1.5	Silty Gravel

Source:
https://srk.sharepoint.com/sites/NA503000.040/Internal/050_Databases/[Tetlin_StaticDatabase_481900.030_ld_je_ab_rev10.xlsx]
Note: Logging details provided by Shannon & Wilson

4.2.2 Mineralogical Analyses

The waste rock samples underwent mineralogical analysis at Bureau Veritas Minerals laboratory by QEMSCAN bulk mineral analysis and Reitveld X-Ray diffraction (XRD).

The ore before beneficiation samples also underwent mineralogical analysis at Bureau Veritas Minerals laboratory by QEMSCAN bulk mineral analysis and Reitveld X-Ray diffraction (XRD). In addition, they were submitted for petrographic analysis at Ultra Petrography and Geoscience, Vancouver, BC, Canada. During the petrographic analysis, modal percentages were determined by point-counting analysis.

4.2.3 Static Geochemical Tests

Waste Rock

The waste rock samples underwent acid-base accounting (ABA), including paste pH, modified NP (MEND 1991), total sulfur (LECO), sulfate sulfur (HCl-extractable), sulfide sulfur (by difference between total sulfur and HCl-extractable), total carbon and total inorganic carbon (CO_2 HCl method). Elemental analysis was determined using aqua regia digestion followed by inductively coupled plasma mass spectrometry (ICP-MS). Aqua regia digestion was used rather than four-acid digestion to specifically target volatile elements such as arsenic and antimony, and to better reflect those elements that could potentially be released.

Construction Materials

The construction materials were analyzed according to the same analysis suite as the waste rock samples but analysis of total carbon, total inorganic carbon, total sulfur and the elemental analysis was sub-contracted by Bureau Veritas to Actlabs, Canada.

Ore and Tailings Samples

The ore and detoxified tailings samples were analyzed for acid base accounting at McClelland Laboratories. The ABA suite included paste pH, total sulfur, sulfate sulfur (H_2O soluble sulfate and HCl rinse) and neutralization potential determined by titration as per MEND guidelines (1991). SRK calculated sulfide sulfur as the difference between total sulfur and H_2O soluble sulfate due to the presence of pyrrhotite which can be digested by HCl acid. ALS Laboratories analyzed the ore and detoxified tailings samples for total carbon and inorganic carbon by $HClO_4$ digestion and CO_2 coulometer analysis and multi-elemental analysis by four acid digestion and ICP-MS.

4.2.4 Leach Tests

Waste Rock

Two waste rock samples have been submitted for a sequential meteoric water mobility procedure (SMWMP) because sufficient material was not available to conduct onsite field barrel tests.

The SMWMP is a modified version of the MWMP test where an unsaturated column of rock is drip-leached with a 1:1 mass ratio of distilled water. The standard MWMP test involves a single leaching step whereas during the modified procedure, the leachate is collected, a split is analyzed, and the remainder reapplied to an un-leached sample of the same material in a sequential manner for several steps (depending upon the sample size). The effluent is analyzed at each step and the sample mass is reduced to maintain a liquid to solid ratio of 1:1.

Construction Materials

The construction samples underwent a Meteoric Water Mobility Procedure (MWMP) according to standard test method (ASTM E2242-13). The test involves a single leaching event of an unsaturated column of rock which is drip-leached with a 1:1 mass ratio of distilled water over the course of 24 hours. The resulting leachate was submitted for analysis of pH, electrical conductivity (EC), oxidation reduction potential (ORP), major anions, major cations and trace elements. There was insufficient sample to conduct an MWMP on sample TP01, S-1 and the MWMP was not completed for sample TP19, S-2 due to poor drainage.

Ore and Tailings Samples

The three ore and five detoxified tailings samples also underwent MWMP testing according to standard test method (ASTM E2242-13) at McClelland Laboratories with extract analysis conducted at WETLab Laboratories. The resulting leachate was submitted for analysis according to the Nevada Division of Environmental Protection (NDEP) Profile II[2] parameters.

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[2] SRK recognises that Profile II is no longer typically used by NDEP and is replaced by Profile I and Profile III. Profile II has been used in order to comply with Fort Knox permit conditions and the list of Profile II parameters is consistent with Profile I/III with the exception of uranium which is a new addition to the NDEP profiles and not considered an element of concern for the project.

In addition, the process solutions were collected after cyanide detoxification and analyzed by WETLab Laboratories for Profile II parameters and WAD cyanide.

4.2.5 Laboratory Kinetic Humidity Cell Tests

HCT testing is being undertaken according to the ASTM standard method (ASTMD-5744-18, Option A) by Bureau Veritas Laboratories. The method is designed to simulate water-rock interactions in order to predict the rate of sulfide mineral oxidation and therefore acid generation and metals mobility. Under ASTM methodology, the test is carried out on material sized to pass a 6.3 mm (0.25 inch) Tyler screen. The test follows a seven-day cycle during which air that is humidified and at a temperature of 25°C is introduced at the bottom of the column for three days of each cycle followed by three days of dry air. On the seventh day, the sample is rinsed with distilled water and the extracted solution is collected for analysis.

Key parameters including pH, electrical conductivity and oxidation reduction potential are measured on a weekly basis. The following parameters are analyzed on a weekly basis for the first five cycles, and then bi-weekly: sulfate, acidity, alkalinity, chloride, fluoride, nitrate, nitrite, ammonia total dissolved phosphorus dissolved trace elements by ICP-MS, low level selenium, and dissolved mercury by cold vapor method.

Geochemical reactions and reaction rates monitored throughout the testing include sulfide oxidation, depletion of neutralization potential (NP), and mineral dissolution (INAP, 2014). Termination of the HCTs is assessed when the release rates of key constituents such as pH, sulfate, acidity, alkalinity and iron as well as dissolved metals and metalloids become relatively constant with time and there is no substantial change in the calculated release rate (INAP, 2014). The INAP (2014) protocol does not provide a method for quantifying when ‘relatively constant’ conditions have been achieved.

4.2.6 On-Site Kinetic Barrel Tests

On-site barrel tests were commissioned in July 2022. Representative sample splits of the composited barrel materials have been submitted to BV Laboratories and test work is currently underway. BV is generating three sample splits per barrel which can be sieved to produce the following size fractions:

- First sample will be sieved to -1/4 inch
- Second sample will be sieved to -2 mm
- Third sample will be sieved to:
  - +1/4 inch
  - -1/4 inch +2 mm
  - -2 mm +200 mesh
  - -200 mesh

The sieved fractions will then undergo the following tests:

- -1/4 inch material:
  - QXRD and QEMSCAN
  - Optical mineralogy on polished thin section
  - HCT
- -2 mm material:
  - Rinse pH and rinse EC

- All other size fractions:
    - Modified ABA package (paste pH, Total S by Leco, and NP)
    - Sulfate sulfur (HCl extractable) and sulfide sulfur (by difference)
    - Total carbon
    - Carbonate carbon (CO_2 HCl method)
    - Ultra-trace metals on solids by aqua regia digestion

The onsite barrel tests are designed to assess the effects of site conditions and scale on mine waste leaching behavior. They are important to help calibrate the kinetic humidity cell tests to field conditions. The barrels are monitored weekly and sampled as soon as enough leachate is available for analysis during times when the temperature is above 0°C. The amount of water passing through the barrel is recorded each time leachates are sampled to calculate constituent loads (e.g., in units of mg constituent/kg of material/week). Typically, the difference between laboratory loading rates from humidity cells and field loading rates form barrel tests is one to two orders of magnitude. Barrel tests allow for a more specific calibration of element release rates.

The leachates will be analyzed in the field for pH, electrical conductivity, dissolved oxygen and redox potential and temperature then submitted to ACZ Laboratories for analysis of pH, EC, ORP, acidity, alkalinity, hardness, total suspended solids, total dissolved solids, bromine, chloride, fluoride, nitrite, nitrate, ammonia, phosphate, sulfate, dissolved organic carbon, total organic carbon, dissolved trace elements by ICP-MS and dissolved mercury by cold vapor method.

Barrel tests typically run for at least three years, although results available after one year can be used for initial calibration.

4.3 QA/QC

4.3.1 Waste Rock

Static Testwork

ABA and elemental analysis results were checked for accuracy and precision using field and laboratory duplicates, method blanks, and conformance to certified reference materials. All analytes passed internal laboratory quality control programs.

The following additional checks were undertaken by SRK:

- Total sulfur ≥ sulfur as sulfate (within ±10%).
- Total carbon ≥ total inorganic carbon (within ±10%).
- NP duplicates were within ±5 kg $CaCO_3$/t for NP <10 kg $CaCO_3$/t, and within 20% relative percent difference (RPD) for samples ≥10 kg $CaCO_3$/t.
- Certified reference materials within certified tolerance ranges.
- Method blanks either below method detection limit, or within ten times the method detection limit.

QA/QC results for the historical programs are reported in SRK (2013), SRK (2018). QA/QC results for the waste rock samples are summarized in Table 4-6. One sample exceeded the SRK criteria of +/-20% relative percentage difference (RPD) between total sulfur by LECO and ICP sulfur, however this exceedance was also repeated in the split duplicate sample. The laboratory confirmed that sulfur was likely not fully digested during the aqua regia digest prior to the ICP analysis and to therefore use the LECO result as the true total sulfur value.

Table 4-7: Summary of QA/QC on Waste Rock Samples

QC Test	SRK QC Criteria	Results
Paste pH		
Lab Duplicate (n=1)	For any samples, +/- 0.5 difference pH unit	All passed.
Total C and TIC		
Lab Blank (n=1)	<2X detection limit (DL)	All passed.
Carbon balance (Total C > TIC) (n=7)	For samples > 10X the detection limit (DL), Total Carbon should be greater than Total Inorganic Carbon, if not the % difference should be within +/-20%	All passed.
Lab Duplicate (n=0) for Total C, (n=1) for TIC	For samples > 10X the detection limit (DL), % RPD within +/-20%	#N/A
Standard Reference Material (n=1)	Within specified tolerance ranges.	All passed.
Total S & Total Sulfate		
Lab Blank (n=1)	<2X detection limit (DL)	All passed.
Sulfur balance (total S > sulfate S) (n=7)	For samples > 10X the detection limit (DL), Total Sulfur should be greater than Total Sulfate, if not the % difference should be within +/-20%	All passed.
Lab Duplicate (n=0) for Total S, (n=1) for Total Sulfate	For samples > 10X the detection limit (DL), % RPD within +/-20%	All passed.
Standard Reference Material (n=1)	Within specified tolerance ranges.	All passed.
Modified NP		
Lab Blank (n=1)	Within -2.50 to 2.50 NP Kg CaCO3/t.	
NP consistent with paste pH (n=7)	Negative NP has paste pH <= 5	All passed.
Lab Duplicate (n=1)	% RPD better than +/-15% for NP>20 kg/t, % RPD better than +/-20% for NP>10 kg/t, Difference within +/-5kg/t for NP<10 kg/t. Fizz test rating is the same.	All passed.
Fizz test rating with NP (n=7)	Max NP does not exceed fizz test rating	All passed.
Modified NP and TIC		
Comparison between Modified NP and total inorganic carbon (TIC) (n=7)	Check for trends/co-relation	NP generally higher than TIC.
Total S-LECO and S-ICP		
Comparison between Total S-LECO and S-ICP (n=7)	For samples >10X detection limit (DL), % RPD within +/-20%	3461315 failed, but the split dup was also the same.
Trace Elements (Aqua Regia Digestion with ICP Finish)		
Lab Blank (n=1)	<5X Detection Limit	All passed.
Lab Duplicate (n=1)	For samples >10X detection limit (DL), % RPD within +/- 20%, For ICP metal scan, it is acceptable for 10% of parameters to be outside of this criterion.	All passed.
Standard Reference Material (n=2)	Within specified tolerance ranges.	All passed.

Source: https://srk.sharepoint.com/sites/NA503000.040/Internal/020_Project Data/Lab/2021_Pre-HCT ABA/[C129658-SRK-Mahn Choh_QAQC_rtc_done.xlsx]

Kinetic Humidity Cells

Bureau Veritas conducts an inhouse QA/QC program for HCT samples that includes analyzing inhouse duplicates, matrix spikes, method blanks and certified reference materials. In addition, SRK conduct the following inhouse QA/QC checks:

- Ion balance when EC>100 µS/cm, % difference should be within +/-10%.
- Trend analysis (visual check).
- HCT method blank - within 10X detection limit (DL), and trend analysis (visual check).
- Leachate duplicates where parameter is > 10X DL, % RPD within +/- 20%.

The trend analysis identified a number of anomalous values where concentrations increased for a short period. The laboratory rechecked archived leachates with resulting data typically re-confirming the original result. There is a possibility that these anomalous values could represent contamination but are not of a significant concern where concentrations rapidly return to pre-elevated levels. SRK deemed the majority of data acceptable. Several rechecks are currently outstanding with the laboratory including:

- Anomalously high values for Tetlin HC-1 Pb at Week 153
- Anomalously high value for arsenic in Manh Choh HC-7 at Week 60 and variability between Manh Choh HC-7 and duplicate HC-8 for a number of parameters over numerous weeks.

4.3.2 Ore and Tailings

Static Testwork

SRK has conducted internal QA/QC checks on the three ore samples, detoxified tailings solids and detoxified tailings solution. The QA/QC results are presented in Table 4-8 and Table 4-9 respectively and all results are acceptable.

Table 4-8: Summary of QA/QC on Ore Samples

QC Test	SRK QC Criteria	Results
Modified NP		
NP consistent with paste pH	Negative NP has paste pH below <=5	All passed.
Total S & Total Sulfate		
Sulfur balance (Total S > Sulfate S[1]) (n=3)	For samples > 10X the detection limit (DL), Total Sulfur should be greater than Total Sulfate, if not the % difference should be within +/-20%	All passed.
Sulfur balance (Total S > Non Extractable S) (n=3)	For samples > 10X the detection limit (DL), Total Sulfur should be greater than Non Extractable S, if not the % difference should be within +/-20%	All passed.
LECO-S and S-ICP		
Comparison between Total S-LECO and S-ICP (n=3)	For samples >10X detection limit (DL), % RPD within +/-20%	All passed.
MWMP		
Ion Balance (n=3)	EC>100 uS/cm, % difference should be within +/-10%	All passed.

Source: https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 500 Tailings Characterization/Lab Results/[4646 Enviro Results Update_QAQC_rtc_rev01.xlsx]
Note 1: H_2O-Soluble Sulfate, Non-H_2O Sulfate Sulfur

Table 4-9: Summary of QA/QC on Detoxified Tailings Solid Samples and Detoxified Solutions

QC Test	SRK QC Criteria	Results
Modified NP		
NP consistent with paste pH (n=5)	Negative NP has paste pH below<= 5	All passed.
Total S & Total Sulfate		
Sulfur balance (Total S > Sulfate S) (n=5)	For samples > 10X the detection limit (DL), Total Sulfur should be greater than Total Sulfate, if not the % difference should be within +/-20%	All passed.
LECO-S and S-ICP		
Comparison between Total S-Leco and S-ICP (n=5)	For samples >10X detection limit (DL), % RPD within +/-20%	4646-001 (Air) is 21.6% RPD. Slightly outside the criteria, but Total S-Leco > S-ICP so this is acceptable.
MWMP		
Ion Balance (n=5)	EC>100 uS/cm, % difference should be within +/-10%	All passed.
Comparison between TDS-Lab and TDS$^-$Calc. (n=5)	For samples >10X detection limit (DL), % RPD within +/-30%	All passed.
Bulk Leach Test		
Ion Balance (n=5)	EC>100 uS/cm, % difference should be within +/-10%	All passed.
Comparison between TDS^1-Lab and TDS$^-$Calc. (n=5)	For samples >10X detection limit (DL), % RPD within +/-30%	All passed.

https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 500 Tailings Characterization/Lab Results/[4646 Enviro Report Tables_20220912_QAQC_rtc.xlsx]

Kinetic Testwork

QA/QC checks are undertaken on the ore humidity cell test results using the same methods as detailed in Section 4.3.1 for waste rock. The majority of data have been acceptable to date except for several anomalous results identified through the trend analysis. These results are currently undergoing a recheck with the laboratory and include anomalously high values for Kinross HC-01 for NH4 (Week 16), Bi, Fe, P (Week 14) and Pb (Week 18). These anomalous results do not alter the overall conclusions.

4.3.3 Construction Materials

Table 4-9 summarizes the QA/QC for the ABA and multi-element analysis which included two split duplicates created by BV for samples TP21, S-2 and GP01, S-1. Field duplicates were not obtained. The majority of the ABA and multi-element results were deemed acceptable, apart from some internal method blanks and standard reference material samples which reported concentrations outside of specified tolerance limits for several parameters including Au, Ba, Na, Sb, W, Mg, Cr, Zn, Pb and Zr. The laboratory confirmed that these differences are the result of certain mineral phases not being fully digested through aqua regia.

Table 4-10 summarizes the QA/QC for the MWMP test, no solid sample duplicates were included as part of this program due to material availability, but three duplicate leachates were included in the analysis. Nine samples reported ion balance results outside of the acceptability criteria due to an excess of cations to anions. Where the ion balance reported a difference greater than +/- 10% there was a poor correlation between EC and the anions. Since alkalinity is the dominant anion, it is possible that this was under-reported in these samples and a re-check was requested through the laboratory. Chloride and sulfate was reported below detection limit in some samples and excluded from the ion balance calculation. The laboratory confirmed that some of the samples were coloured and dilution was applied before analysis of sulfate and chloride but they were unable to re-analyze these two anions without dilution. Re-analysis of alkalinity was undertaken on all but three samples which had insufficient volume. The re-analysis was undertaken outside of the laboratory holding time. In all instances, alkalinity concentrations were reported higher in the re-analysis but this only altered the ion balance acceptability on one sample and eight were still outside of the acceptability criteria with an excess of cations to anions.

Table 4-10: QAQC Summary ABA and Trace Element Analysis

QC Test	SRK QC Criteria	Results
Paste pH		
Lab Duplicate (n=3)	For any samples, +/- 0.5 difference pH unit	All passed.
Split Duplicate (n=2)	For any samples, +/- 0.5 difference pH unit	All passed.
Total C and TIC		
Method Blank (n=2) for TIC	<2X detection limit (DL)	All passed.
Carbon balance (Total C > TIC) (n=24)	For samples > 10X the detection limit (DL), Total Carbon should be greater than Total Inorganic Carbon, if not the % difference should be within +/-20%	All passed.
Lab Duplicate (n=3) for Total C and (n=3) for TIC	For samples > 10X the detection limit (DL), % RPD within +/-20%	All passed.
Split Duplicate (n=2) for Total C and (n=2) for TIC	For samples > 10X the detection limit (DL), % RPD within +/-30%	All passed.
Standard Reference Material (n=15) for Total C, (n=4) for TIC	Within specified tolerance ranges.	All passed.
Total S & Total Sulfate		
Method Blank (n=1) for SO4	<2X detection limit (DL)	Passed
Sulfur balance (total S > sulfate S) (n=24)	For samples > 10X the detection limit (DL), Total Sulfur should be greater than Total Sulfate, if not the % difference should be within +/-20%	All passed.
Lab Duplicate (n=2) for Total S, (n=1) for Total Sulfate	For samples > 10X the detection limit (DL), % RPD within +/-20%	All passed.
Split Duplicate (n=2)	For samples > 10X the detection limit (DL), % RPD within +/-30%	All passed.
Standard Reference Material (n=1) for SO4 and (n=20) for Total S	Within specified tolerance ranges.	All passed.
Modified NP		
Method Blank (n=2)	within -2.50 to 2.50 NP Kg CaCO3/t.	All passed.
NP consistent with paste pH (n=24)	Negative NP has paste pH <= 5	All passed.

QC Test	SRK QC Criteria	Results
Lab Duplicate (n=2) for NP, (n=0) for fizz test	% RPD better than +/-15% for NP>20 kg/t, % RPD better than +/-20% for NP>10 kg/t, Difference within +/-5kg/t for NP<10 kg/t. Fizz test rating is the same.	All passed.
Split Duplicate (n=2) for NP and (n=2) for fizz test	% RPD better than +/-15% for NP>20 kg/t, % RPD better than +/-20% for NP>10 kg/t, Difference within +/-5kg/t for NP<10 kg/t. Fizz test rating is the same.	All passed.
Fizz test rating with NP (n=24)	Max NP does not exceed fizz test rating	All passed.
Standard Reference Material (n=2) for NP	Within specified tolerance ranges.	All passed.
Modified NP and TIC		
Comparison between Modified NP and TIC (n=24)	Check for trends/co-relation	NP generally higher than TIC.
Total S-Leco and S-ICP		
Comparison between Total S-Leco and S-ICP (n=24)	For samples >10X detection limit (DL), % RPD within +/-20%	All passed.
Trace Elements (4 Acid Digestion with ICP Finish)		
Method Blank (n=4)	<5X Detection Limit	The following parameters failed: Na, Zn, Ga, Ba and Au.
Lab Duplicate (n=2)	For samples >10X detection limit (DL), % RPD within +/- 20%, For ICP metal scan, it is acceptable for 10% of parameters to be outside of this criterion.	All passed.
Standard Reference Material (n=13)	Within specified tolerance ranges.	A number of parameters were outside tolerance ranges including Ba, Sb, Au, W, Mg, Cr, Zn, Pb and Zr.

Source: https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 600 Construction Material/Testwork Results/Raw Data/[C187774-Peak Gold-Kinross Manh Choh_QAQC_mlt.xlsx

Table 4-11: QAQC Summary MWMP

QC Test	SRK QC Criteria	Results
Method Blank (n=2)	<5X Detection Limit	All passed.
Ion Balance (n=22)	EC>100uS/cm, % difference should be within +/-10%	Eight samples failed ion balance checks reporting an excess of cations to anions.
Leachate Duplicate (n=3)	For samples > 10X the detection limit (DL), % RPD within +/-20%	All passed.

Source: https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 600 Construction Material/Testwork Results/Raw Data/[C187805-SRK Consulting-Manh Choh (MWMP)_QAQC_mlt.xlsx

4.4 Test Program Chronology and Status

Table 4-8 shows the schedule and current status of various components of the characterization program, schedule, and current status.

Table 4-12: Test Program Chronology

Program	Requirements	Methods	Status	
Waste Rock & Pit Wall Rock Characterization	ML/ARD characteristics of each material type representing majority of waste rock tonnages Spatial variation of ML/ARD and metal leaching	Static testing (ABA and multi-element analysis) on historical core	Complete	
		Static testing (ABA and multi-element analysis) on 2020 Met and Geotech drillcore samples	Complete	
		Static testing (ABA and multi-element analysis) on 2021 Infill and Geotech drillcore samples	Pending	Estimated initiation Q4 2022
		Static testing (ABA, multi-element analysis and MWMP) on barrel materials (and 2 x oxides undergoing SMWMP)	Ongoing	Estimated completion Q4 2022
	Occurrences of minerals (types, crystal form, occurrence) Mineralogical occurrence of critical contaminants Mineralogy of carbonates as well as Ca, Mg and Fe content needs to be determined to allow refinement of block model NP	Mineralogical analysis QEMSCAN, petrography on historical core	Complete	
		Mineralogical analysis QEMSCAN, petrography on 2020 Met and Geotech drillcore samples	Complete	
		Mineralogical analysis QEMSCAN, petrography on 2021 Infill and Geotech drillcore samples	Pending	Estimated initiation Q4 2022
		Mineralogical analysis QEMSCAN, petrography on barrel materials (and 2 x oxides undergoing SMWMP)	Ongoing	Estimated completion Q4 2022
	Rate of depletion of sulfides and acid neutralizing minerals and correlation with bulk characteristics Rate of release of contaminants under non-acidic and acidic conditions	Kinetic testing – laboratory humidity cells on historical core	Ongoing	Reported to Week 161
		Kinetic testing – laboratory humidity cells on 2020 Met and Geotech drillcore samples	Ongoing	Reported to Week 62
		Kinetic testing – laboratory humidity cells on 2021 Infill and Geotech drillcore samples	Pending	Estimated initiation Q4 2022
		Kinetic testing – laboratory humidity cells on barrel materials	Pending	Estimated initiation Q3 2022
		Sequential meteoric water mobility procedures (SMWMP) on 2 x oxide samples which do not have an equivalent barrel	Pending	Estimated initiation Q4 2022
		Kinetic testing – onsite field barrels	Ongoing	Initiated Q3 2022
Construction Material	ML/ARD characteristics for various material sources Lithological and chemical composition of material sources	Static testing (ABA, multi-element and MWMP) on test pit samples	Complete	
		Static testing (MWMP) on a subset of test pit samples	Complete	
Tailings Characterization	ML/ARD characteristics	Static testing (ABA, multi-element, MWMP) on tailings solids post cyanide detox	Complete	
	Occurrences of minerals (types, crystal form, occurrence)	Mineralogical analysis QEMSCAN, petrography	Pending	To be determined on selected representative tailings material
	Provide comparison with existing Fort Knox liquor	Profile II analysis on processed tailings liquor post cyanide detox	Complete	Complete
	Rate of depletion of sulfides and acid neutralizing minerals and correlation with bulk characteristics	Potential kinetic testing (laboratory humidity cells)	To be determined on most representative tailings material	
Ore Stockpiles	ML/ARD characteristics	Static testing (ABA, multi-element, MWMP)	Complete	
	Occurrences of minerals (types, crystal form, occurrence)	Mineralogical analysis QEMSCAN, petrography	Complete	
	Rate of depletion of sulfides and acid neutralizing minerals and correlation with bulk characteristics Rate of release of contaminants and correlation with bulk characteristics	Kinetic testing (laboratory humidity cells)	Ongoing	Reported to Week 24

Source:
https://srk.sharepoint.com/sites/NA503000.040/Deliverables/080_Deliverables/07.ProjectSchedule/[ProjectSchedule_SRK_Draft_503000.040_20212107_BKK 3_13_ld_mc.xlsx]

5 Characterization Results

5.1 Waste Rock

During interpretation of the characterization results, samples were categorized into oxide and sulfide material using the logged oxidation data provided within the exploration drillcore database:

- “Null” classification was interpreted as sulfide material
- “1” classification was interpreted as transition material
- “2”, “3” and “4” classification was interpreted as oxide material

For the purposes of the characterization, and to maintain consistency with the block model domaining recommendations, material classified as ‘transition’ is handled as ‘sulfide’ (SRK, 2021b).

5.1.1 Mineralogy

Mineralogy was undertaken on the humidity cell waste rock samples to determine the mineralogical controls on acid generation and metal/metalloid release. Table 5-1 presents a summary of the results laboratory reports are included in Appendix A.

Pyrite was identified as the main sulfide mineral in the historic humidity cells and was present in all samples ranging from 0.09% (trace) to 2.6% (minor) amounts. Trace pyrrhotite (<2%) was also present in eight of the historic humidity cell samples at 0.05% to 0.98%. .

The majority of the 2021 humidity cells targeted oxide materials where no sulfides were identified, except for the QMS oxide sample from South Pit (HC-5) which reported 0.3% pyrrhotite. The calc-schist sulfide sample from North Pit (HC-6) reported 0.2% sulfides (mainly pyrite) and the skarn sulfide from South Pit (HC-7) reported major pyrrhotite content (14%) plus trace pyrite and arsenopyrite content (1% and 0.4% respectively).

The primary carbonate minerals were calcite/dolomite which were present in 14 of the 16 humidity cells ranging from 0.01% to 6.6% weight equivalent.

5.1.2 Acid Potential

Table 5-2 presents a statistic summary of the ABA results. Paste pH values ranged between pH 4.5 and 9.5 in the South Pit deposit and between pH 6.1 and 8.9 in North Pit. Paste pH was typically lower in the materials logged as oxide (Figure 5-1 and Figure 5-2) and the skarn samples typically reported the lower paste pH values overall. 6% of samples were classified as acidic based on pHs below the pH of the deionized water used in the test. Other samples had pHs typically above 6 which is consistent with buffering by calcite and dolomite.

Table 5-1: Summary of Mineralogy Results for Samples in Waste Rock Humidity Cells

Mineral Group	Minerals (wt. %)	HC-01	HC-02	HC-03	HC-04	HC-05	HC-06	HC-07	HC-08	HC-09	Manh Choh HC-1	Manh Choh HC-2	Manh Choh HC-3	Manh Choh HC-4	Manh Choh HC-5	Manh Choh HC-6	Manh Choh HC-7
		Skarn Sulfide North Pit	**Skarn Sulfide South Pit**	**Skarn Sulfide South Pit**	**Skarn Sulfide South Pit**	**QMS Oxide South Pit**	**QMS Sulfide South Pit**	**QMS Sulfide South Pit**	**QMS Sulfide South Pit**	**QMS Oxide North Pit**	**Skarn Oxide North Pit**	**Skarn Oxide North Pit**	**Skarn Oxide South Pit**	**Calc-Schist Oxide North Pit**	**QMS Oxide South Pit**	**Calc-Schist Sulfide North Pit**	**Skarn Sulfide South Pit**
		TA7642	**PK19001**	**PK19002**	**TA7158**	**PK19004**	**PK19005**	**TA7638**	**TA7632**	**TA7154**	**ZS8665**	**ZS8666**	**ZS8667**	**ZS8668**	**ZS8669**	**ZS8670**	**ZS8671**
Sulfide Minerals	Chalcopyrite	0.05	0.4	0.05	0.01	0.02	0.02	0.01	0.01	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.61
	Sphalerite/Galena	0.01	0.01	0.01	-	0.01	-	-	0.01	0.01	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Pyrite/Marcasite	1.2	2.6	0.7	0.2	0.8	0.2	0.2	0.09	2.0	<0.1	<0.1	<0.1	<0.1	<0.1	0.11	1.18
	Pyrrhotite	0.3	0.41	1.0	0.1	0.3	-	0.2	0.05	0.6	<0.1	<0.1	<0.1	<0.1	0.27	0.03	14.01
	Arsenopyrite	0.05	-	-	-	-	-	0.1	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.38
	Total Sulfides	**1.6**	**3.4**	**1.7**	**0.4**	**1.1**	**0.2**	**0.5**	**0.2**	**2.7**	**0.0**	**0.0**	**0.0**	**0.0**	**0.3**	**0.2**	**16**
Bulk Silicate Minerals	Quartz	24	46	42	52	43	23	32	28	24	27	28	38	32	45	36	27
	K-Feldspars	18	18	15	3.2	8.5	38	8.8	2.9	23	27	7.0	19	25	8.4	6.9	24
	Plagioclase Feldspar	20	4.6	17	12	15	12	27	16	13	6.3	4.1	16	3.2	7.2	3.8	5.0
	Amphibole (Actinolite / Ferro-Actinolite)	3.3	1.1	3.0	1.3	3.4	4.7	2.7	0.2	5.4	0.8	1.7	2.4	0.2	0.3	0.4	2.7
	Pyroxene (Diopside)	0.2	0.3	0.2	0.3	0.3	0.6	0.4	0.1	0.5	-	-	-	-	-	-	-
	Epidote	-	-	-	-	-	-	-	-	-	0.5	0.5	1.0	0.0	0.1	0.1	2.6
Clay/Mica Minerals	Chlorite / Clinochlore / Chamosite	8.8	6.6	4.8	5.9	4.7	4.5	7.1	12	7.8	9.6	23	6.5	8.3	11	9.8	7.6
	Kaolinite' (clay)	0.6	0.9	0.1	0.3	0.2	0.3	0.2	0.6	0.1	3.6	0.6	2.4	4.3	0.6	0.7	0.2
	Muscovite/Illite	11	10	4.0	19	18	7.5	11	34	11	19	13	10	23	23	31	7.1
	Biotite/Phlogopite	2.2	0.3	0.4	1.9	2.2	2.7	1.9	1.6	1.6	3.1	2.6	2.0	1.1	1.1	0.9	1.7
Phosphate Minerals	Apatite	-	-	-	-	-	-	-	-	-	0.2	0.4	0.2	0.03	0.2	0.1	0.1
Carbonate Minerals	Calcite/Dolomite	1.2	4.8	1.6	1.0	0.4	2.7	2.6	-	3.7	0.03	0.02	-	0.01	0.01	6.6	2.6
Others	Iron Oxides	1.9	1.0	0.2	0.3	0.4	0.7	0.5	0.2	1.5	1.7	18	0.9	2.1	2.3	3.4	1.4
	Almandine	2.9	1.6	1.9	1.4	1.5	1.2	2.6	1.7	2.5	-	-	-	-	-	-	-
	Sphene/Titanite	1.4	0.7	7.4	0.8	1.1	1.5	1.5	0.9	1.7	1.0	0.3	1.0	0.3	0.8	0.2	1.1
	Others	1.4	0.6	0.5	0.3	0.6	0.5	0.5	0.5	1.2	0.1	0.5	0.2	0.1	0.1	0.3	1.0

Source: https://srk.sharepoint.com/sites/NA503000.040/Internal/050_Databases/[Tetlin_StaticDatabase_481900.030_ld_je_ab_rev10.xlsx]

Table 5-2: Statistical Summary of ABA Results and Multi-Element Analysis of Key Parameters for Waste Rock

Material Type		No. of Samples	Paste pH	Sulfide Sulfur (%)	Sulfate Sulfur (%)	TIC (%)	AP* (kg $CaCO_3$/t)	NP* (kg $CaCO_3$/t)	NP*/ AP*	Ag (ppb)	As (ppm)	Cd (ppm)	Co (ppm)	Cu (ppm)	Mn (ppm)	Pb (ppm)	Se (ppm)	Sb (ppm)	Zn (ppm)
10 x Average Crustal Abundance>>										700	130	3	190	450	8,500	200	6	15	950
Calc-Schist Oxide	TET16268	--	7.1	0.11	0.03	0.08	3.4	0.0	0.0	354	255	0.67	66	701	176	12.5	0.30	0.17	54
	TET17348	--	7.0	0.02	0.02	0.08	0.63	0.0	0.0	394	856	0.29	31	140	414	9.7	0.20	5.8	74
Calc-Schist Transition & Sulfide	P05	4	7.3	0.02	0.02	0.08	0.63	0.0	0.0	670	92	0.36	14	130	190	6.4	0.13	0.37	49
	P50		7.7	0.03	0.04	1.5	0.94	32	1.5	1,900	350	1.2	38	220	470	60	0.30	2.3	96
	P95		8.4	0.60	0.06	3.3	19	74	52	5,000	1,200	3.8	52	360	530	220	0.39	6.8	210
QMS Oxide	P05	17	6.2	0.02	0.01	0.04	0.63	0.0	0.0	71	11	0.09	10	28	150	3.0	0.10	0.1	35
	P50		7.9	0.02	0.01	0.08	0.63	1.1	0.5	210	35	0.20	20	87	250	5.0	0.30	0.45	48
	P95		8.7	0.23	0.05	0.46	7.1	10	17	1,000	310	2.6	77	370	770	22	1.0	2.3	220
QMS Transition & Sulfide	P05	32	6.6	0.02	0.01	0.05	0.63	0.0	0.0	82	6.2	0.10	11	24	140	2.6	0.10	0.10	29
	P50		8.1	0.16	0.02	0.20	4.8	4.5	0.7	180	31	0.20	18	70	270	5.3	0.20	0.25	47
	P95		9.3	1.2	0.08	1.9	36	43	12	1,400	330	2.1	41	320	420	12	1.2	1.0	230
Skarn Oxide	P05	22	5.0	0.02	0.01	0.02	0.63	0.0	0.0	160	15	0.06	9.9	55	78	3.2	0.10	0.2	33
	P50		7.2	0.02	0.05	0.08	0.63	0.0	0.0	1,500	330	0.42	28	230	250	15	0.55	2.0	53
	P95		8.4	0.70	0.32	2.7	22	62	4.7	12,000	4,200	3.1	220	1,200	1,100	700	2.1	12	370
Skarn Transition & Sulfide	P05	19	6.4	0.08	0.01	0.07	2.6	0.0	0.0	140	16	0.06	11	40	200	3.4	0.19	0.23	30
	P50		7.7	0.85	0.02	1.2	27	27	0.7	720	52	0.30	27	190	340	12	0.60	0.60	55
	P95		8.7	9.0	0.11	3.5	280	79	3.2	8,100	4,800	4.5	590	2,700	850	81	7.1	4.1	370

Source: https://srk.sharepoint.com/sites/NA503000.040/Internal/050_Databases/[Tetlin_StaticDatabase_481900.030_ld_je_ab_rev10.xlsx]

Notes: Results rounded to 2 significant figures

Gray shading indicated that the result exceeds 10 average crustal abundance for sedimentary shale rocks from Price (1997).

AP*: Site specific acid potential from sulfide calculated as the difference between total sulfur and sulfate sulfur

NP*: Site specific neutralization potential

TIC: Total Inorganic Carbon (reported as CO_2%)

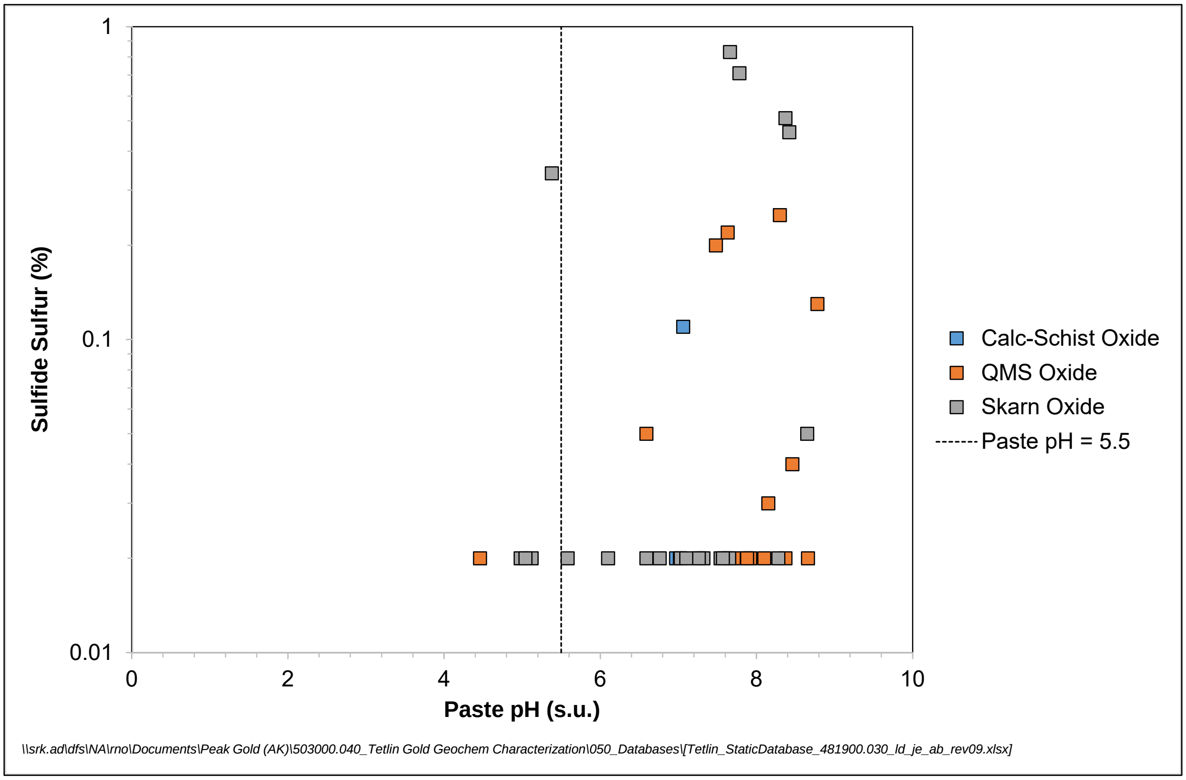

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Figure 5-1: Waste Rock Comparison of Paste pH versus Sulfide Sulfur for Oxide Materials

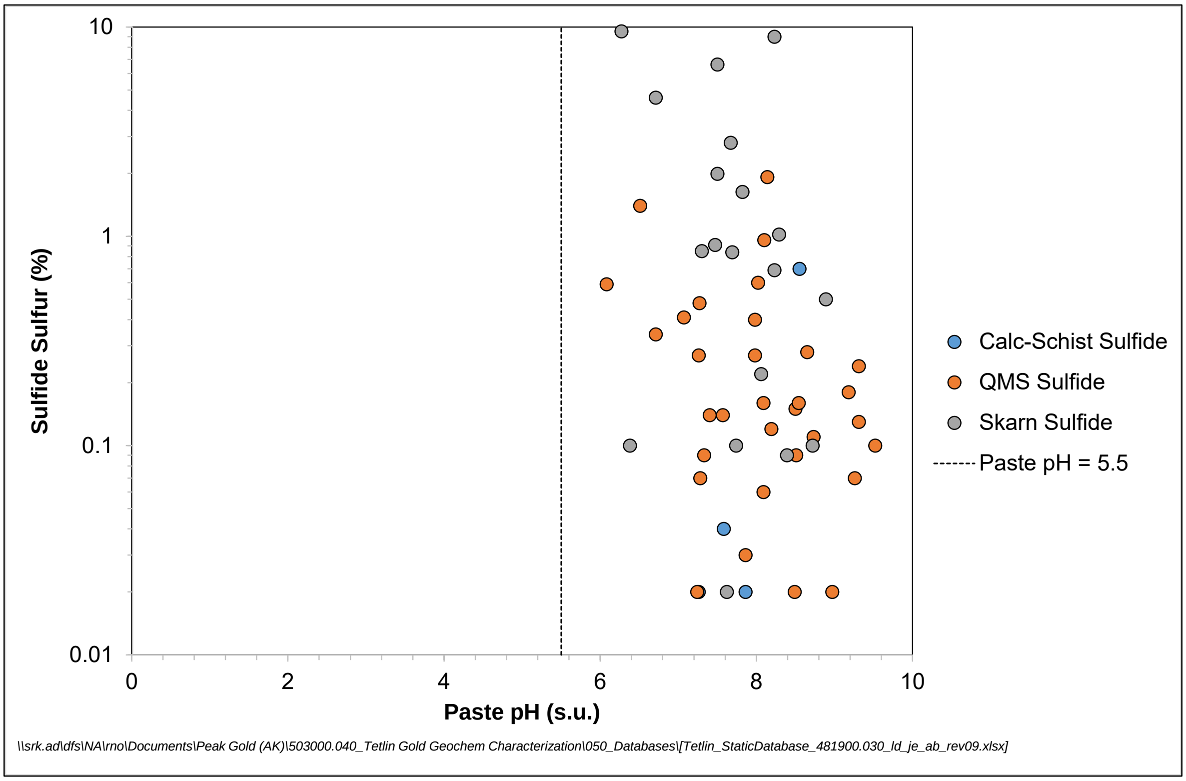

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Figure 5-2: Waste Rock Comparison of Paste pH versus Sulfide Sulfur for Transitional and Sulfide Materials

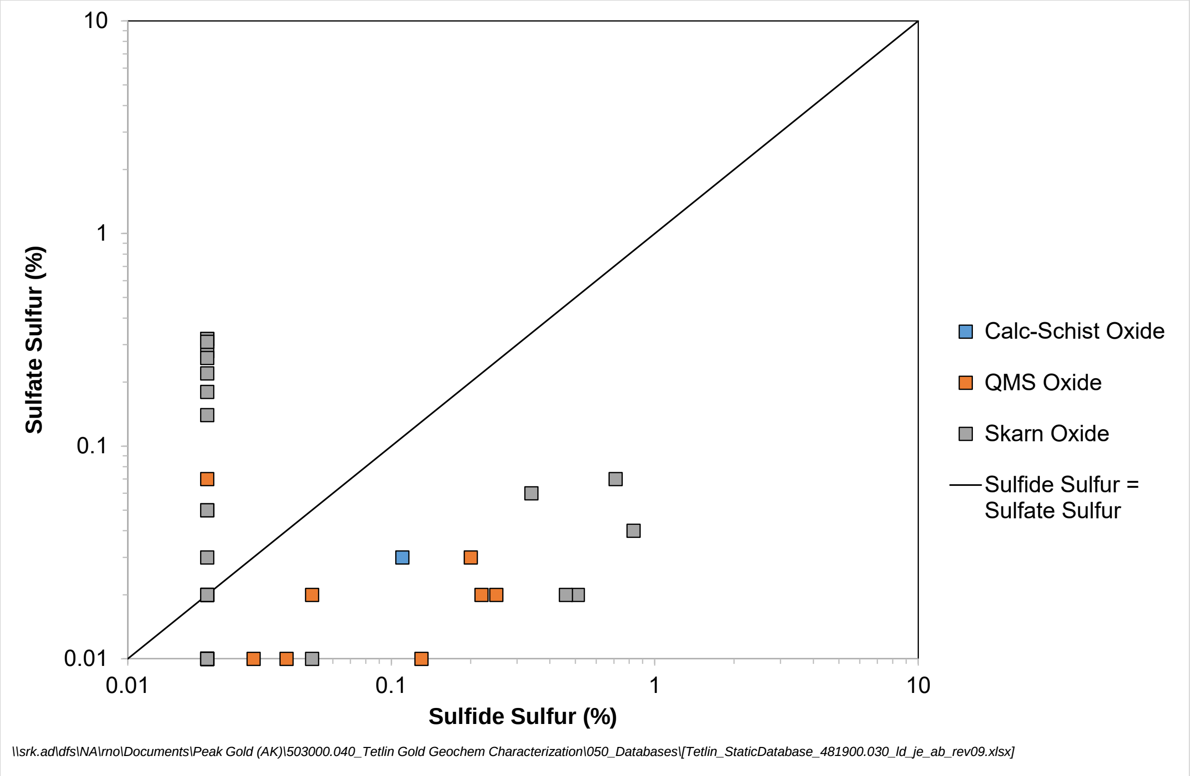

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Figure 5-3: Waste Rock Comparison of Sulfide Sulfur and Sulfate Sulfur for Oxide Materials

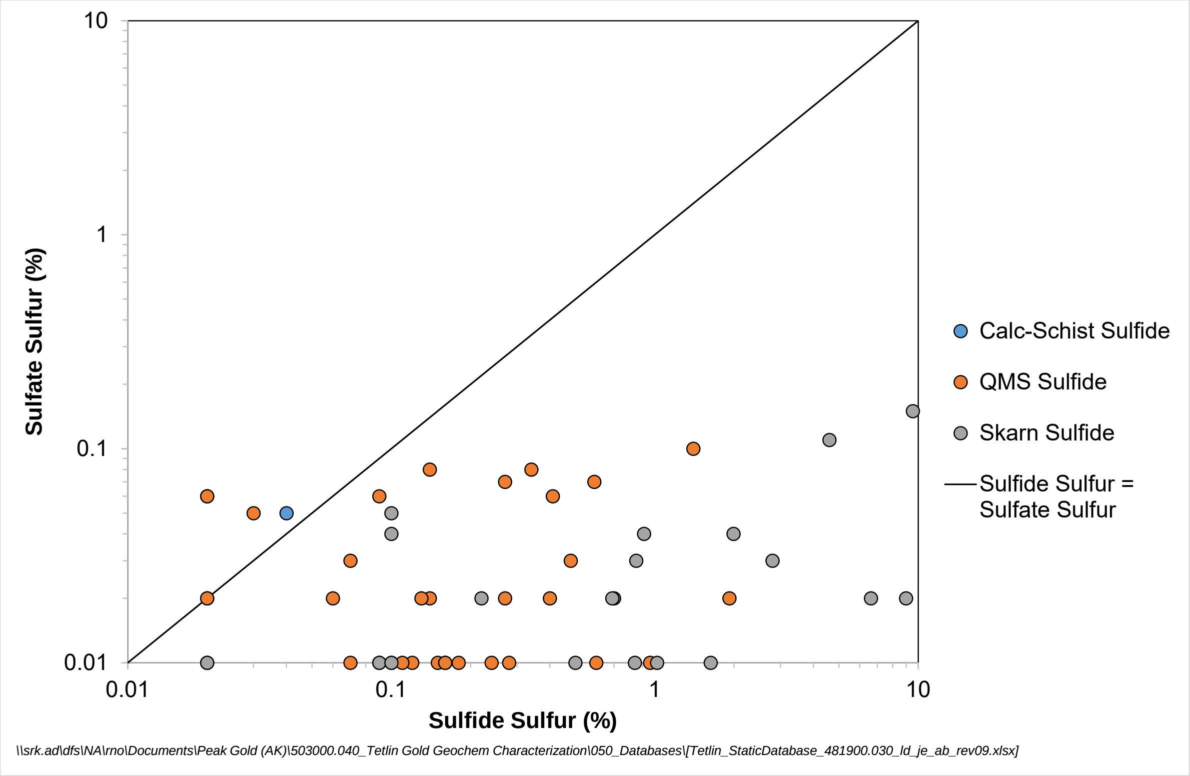

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Figure 5-4: Waste Rock Comparison of Sulfide Sulfur and Sulfate Sulfur for Transitional and Sulfide Materials

Sulfide sulfur is reported at limit of detection where the sulfide sulfur has oxidized to sulfate in a number of the oxide samples, primarily the skarn oxides. It is possible that the sulfates in these oxidized materials are present as some form of readily soluble salts that has the potential to generate acid upon dissolution and hence generate the lower paste pH values.

Sulfur measured using ICP-MS was evaluated for use as a proxy for sulfide sulfur (SRK, 2021b). Results indicated a statistically significant correlation between ICP S measured in the exploration database and sulfide content measured as part of SRK's geochemical baseline study. This enabled the following equation to be generated for the calculation of site-specific acid potential (AP*):

$$AP^{*}(\text{kgCaCO}_3/\text{t}) = 31.25 \times \text{Sulfide S } (\%)$$

where sulfide sulfur is calculated as the difference between total sulfur and sulfate sulfur.

5.1.3 Neutralization Potential

Modified NP has consistently reported higher values in kg $CaCO_3$/t compared to total inorganic carbon (TIC) in the same units (SRK 2013, SRK 2018). This reflects the presence of silicate minerals contributing to the NP measurement but which are unlikely to contribute to the effective neutralization potential under site conditions. Due to the presence of calcite and dolomite, TIC is therefore used directly as to estimate for NP. This assumes the iron content of dolomite is insignificant.

TIC (reported as CO_2%) was consistently lower in the materials logged as oxide relative to sulfide. TIC averaged 0.2 and 0.5% in the QMS oxide and sulfide materials and 0.4 and 1.4% in the skarn oxide and sulfide materials respectively.

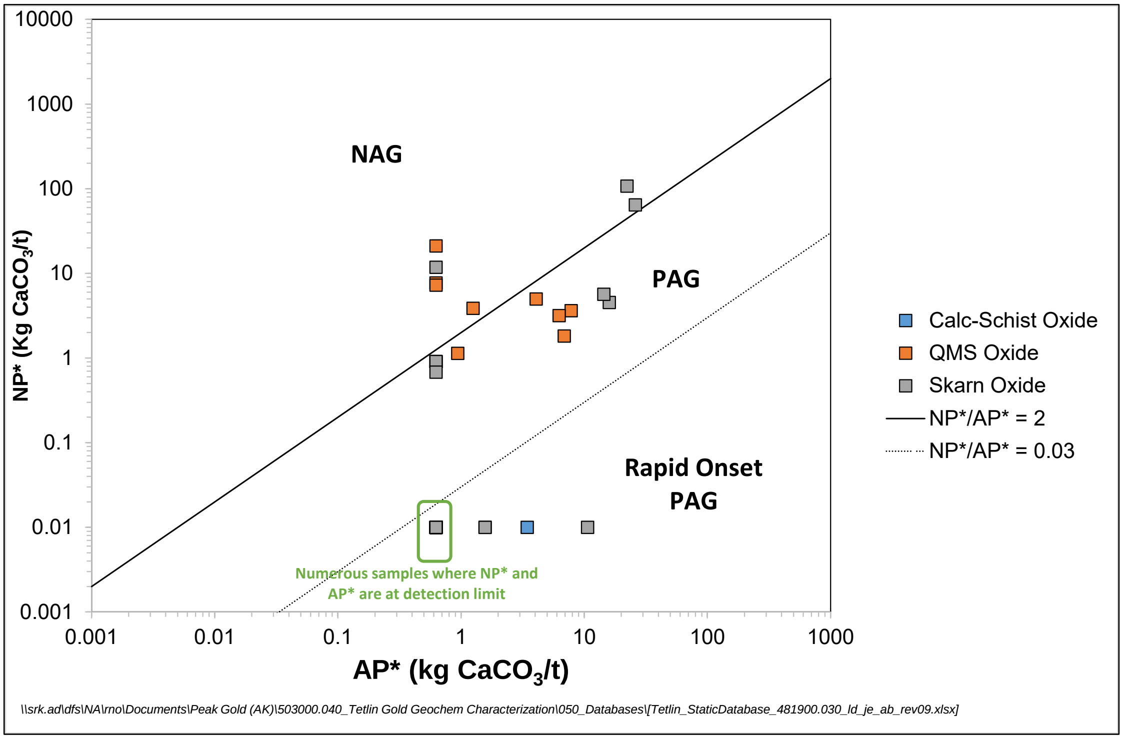
SRK has developed a site-specific neutralization potential (referred to as NP*) which can be calculated directly from TIC using this equation:

$$NP^{*}(\text{kgCaCO}_3/\text{t}) = CO_2(\%) \times \left(\frac{100.08}{44.01}\right) \times 10$$

CO_2(%) is the analytically reported measure of TIC. If TIC is not detected, the concentration should be assigned a value of 0% and NP* is 0 kg $CaCO_3$/t.

5.1.4 Acid Rock Drainage Potential

The ARD potential of the samples was classified on the basis of their NP*/AP* ratios and is presented graphically in Figure 5-5 for oxide materials and Figure 5-6 for sulfide and transitional materials.



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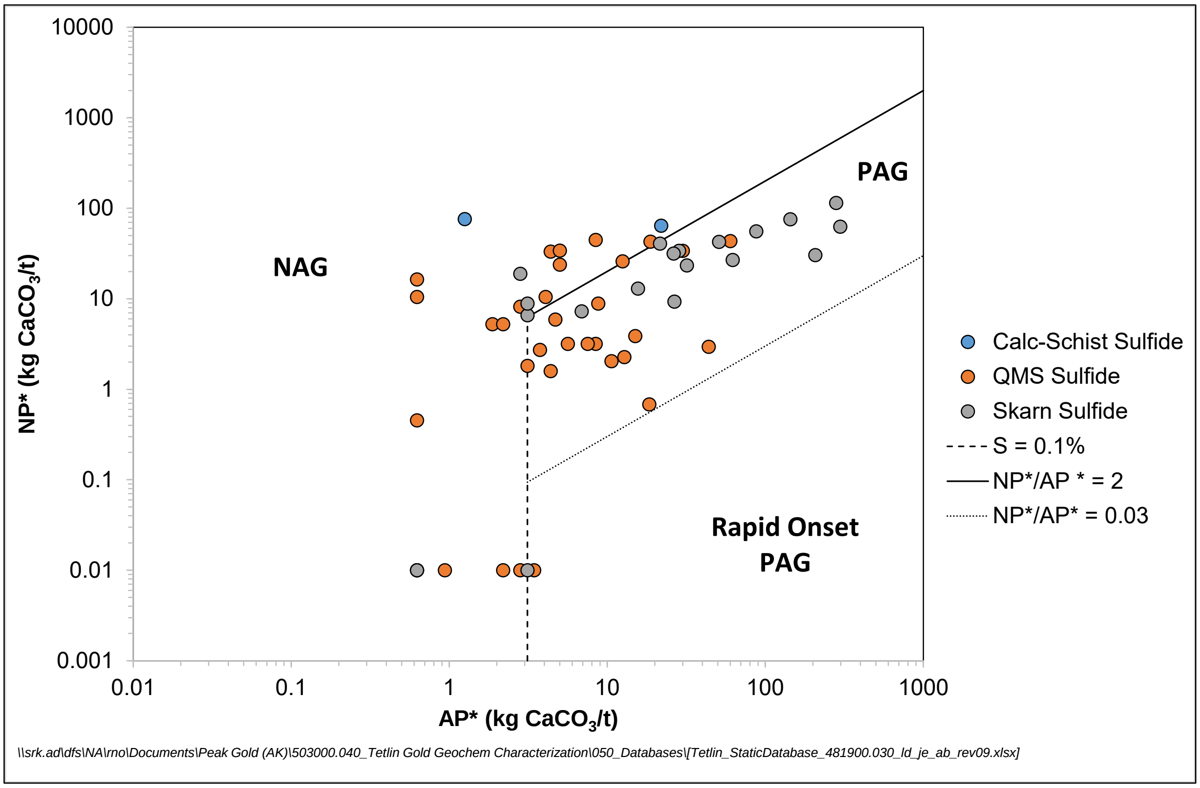
Note: NP* at zero have been set to 0.01 kgCaCO$_3$/t for graphing.

Figure 5-5: Waste Rock Carbonate NP versus AP for Oxide Materials



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Note: NP* at zero have been set to 0.01 kgCaCO$_3$/t for graphing.

Figure 5-6: Waste Rock Carbonate NP versus AP for Transitional and Sulfide Materials

Criteria for evaluating the ARD potential based upon their NP*/AP* was developed following review of the geochemical characterization data and is presented in full in Section 5.2.6.

The classification and criteria results in relation to the static geochemical test results are summarized as follows:

- Material logged as oxide is classified as NAG if NP*/AP* is >2:
  - 24% of the QMS oxide samples and 14% of the skarn oxide samples were classified as NAG on this basis (Figure 5-5)
- Material logged as oxide is classified as Rapid Onset PAG when NP*/AP*<0.03:
  - Both of the calc-schist oxides, 35% of QMS oxides and 68% of skarn oxides had the potential for Rapid Onset PAG (Figure 5-5)
- Material logged as oxide is classified as PAG if NP*/AP*<2:
  - 41% of the QMS oxides and 18% of the skarn oxides were classified as PAG on this basis (Figure 5-5)
- Material logged as transition or sulfide is classified as NAG when NP*/AP*>2 or sulfide S <0.1%:
  - All of the calc-schist sulfide samples, 53% of the QMS sulfide samples and 26% of the skarn sulfide samples were classified as NAG on this basis (Figure 5-6)
- Material logged as transition or sulfide is classified as Rapid Onset PAG if NP*/AP*<0.03 and sulfide S>0.1%:
  - Only one of the QMS sulfide samples demonstrated the potential for Rapid Onset PAG (Figure 5-6)
- Material logged as transition or sulfide is classified as PAG if NP*/AP*<2 and sulfide S>0.1%:
  - 44% of the QMS sulfide samples and 74% of the skarn sulfide samples were classified as PAG (Figure 5-6)

5.1.5 Element Leaching Potential

Table 5-1 presents summary statistics of trace element concentrations for key parameters. The results were compared to ten times global average crustal abundance for shale (Price 1997) to screen for parameters that are elevated in rock with reference to parameters likely to be regulated in water. Elements that exceeded ten times reference value concentrations were:

- Arsenic (2 to 8,000 ppm, relative to threshold of 130 ppm). Highest exceedances occur in in the skarn oxide and sulfide materials but all material types show some exceedance:
  - Arsenopyrite, which typically leaches at higher concentrations than arsenic hosted within the pyrite and iron oxyhydroxides, was identified during the mineralogical study in HC-01 skarn sulfide (0.05%) and HC-07 QMS sulfide (0.14%).
- Copper (16 to 9,700 ppm, relative to threshold of 450 ppm). Predominantly elevated in the skarn oxide and sulfide samples:
- Chalcopyrite was identified in HC-01 to HC-09 between 0.01 and 0.35%.
- Silver (60 to 33,000 ppm, relative to threshold of 700 ppm). Exceedances occur within most material types apart from the calc-schist oxide.
- Cadmium (0.04 to 8.3 ppm, relative to threshold of 3 ppm). A few exceedances occur in each of the material types.

- Cobalt (7.0 to 1,600 ppm, relative to threshold of 190 ppm). Exceedances only occur within the skarn oxide and skarn sulfides.
- Lead (2.3 to 780 ppm, relative to threshold of 200 ppm). Only a few exceedances occur, mainly within the skarn oxides.
- Selenium (0.1 to 9.1 ppm, relative to threshold of 6 ppm). Only a few exceedances occur within the skarn sulfides.
- Sulfur (0.02 to 4.7 ppm, relative to threshold of 2.4 ppm). Only a few exceedances occur within the skarn sulfides.

The leaching potential of these elevated parameters is explored further through the humidity cell tests and onsite field barrel tests.

5.1.6 Humidity Cell Tests

Humidity cell test results for key parameters are presented in Figure 5-7 to Figure 5-32 and full results are included in Appendix B1. pH is circum-neutral for the majority of cells but typically lowest in the oxide humidity cells.

The skarn oxide (Manh Choh HC-3) reported an acidic pH in the early weeks (minimum pH 4.7) but an increasing trend to pH 6.0 at Week 40. The QMS oxide (Manh Choh HC-5) reported pH between 5.3 and 6.2(Figure 5-7). The majority of sulfide materials have remained circum-neutral except for QMS sulfide (Tetlin HC-8) which reported a gradually decreasing trend to pH to 6.1 at Week 117 but remained stable thereafter (Figure 5-8).

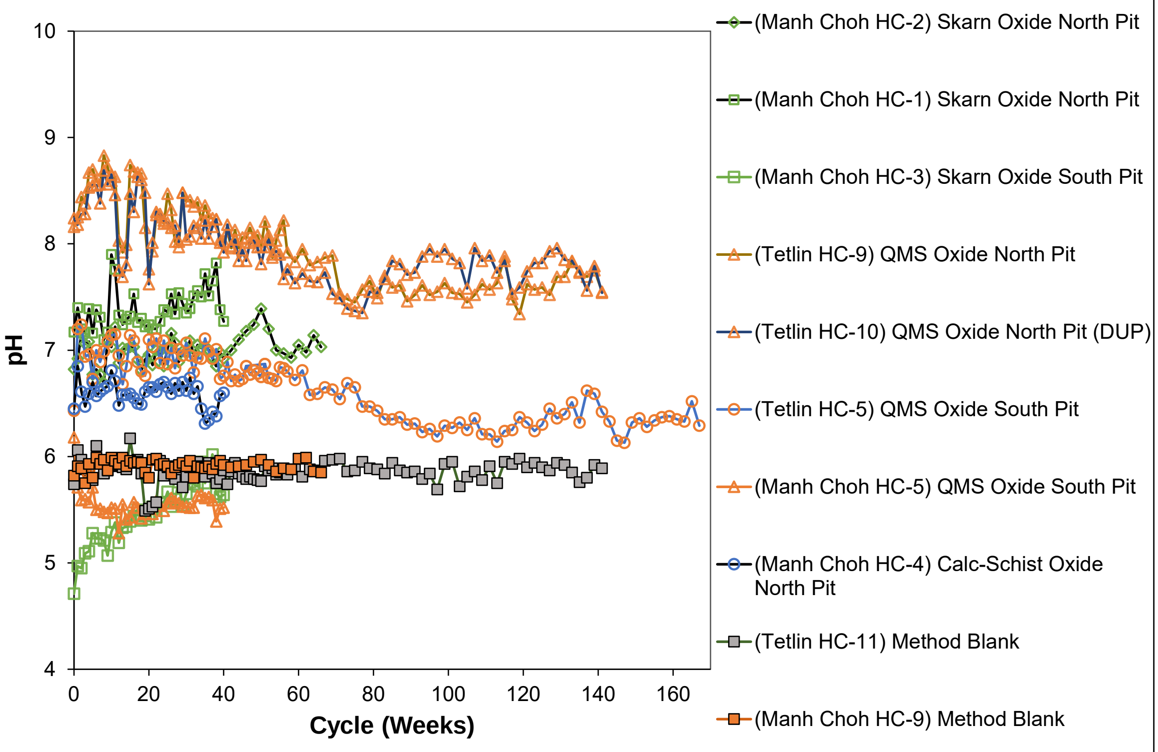

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Figure 5-7: Timeseries Plot of HCT pH for Oxide Materials

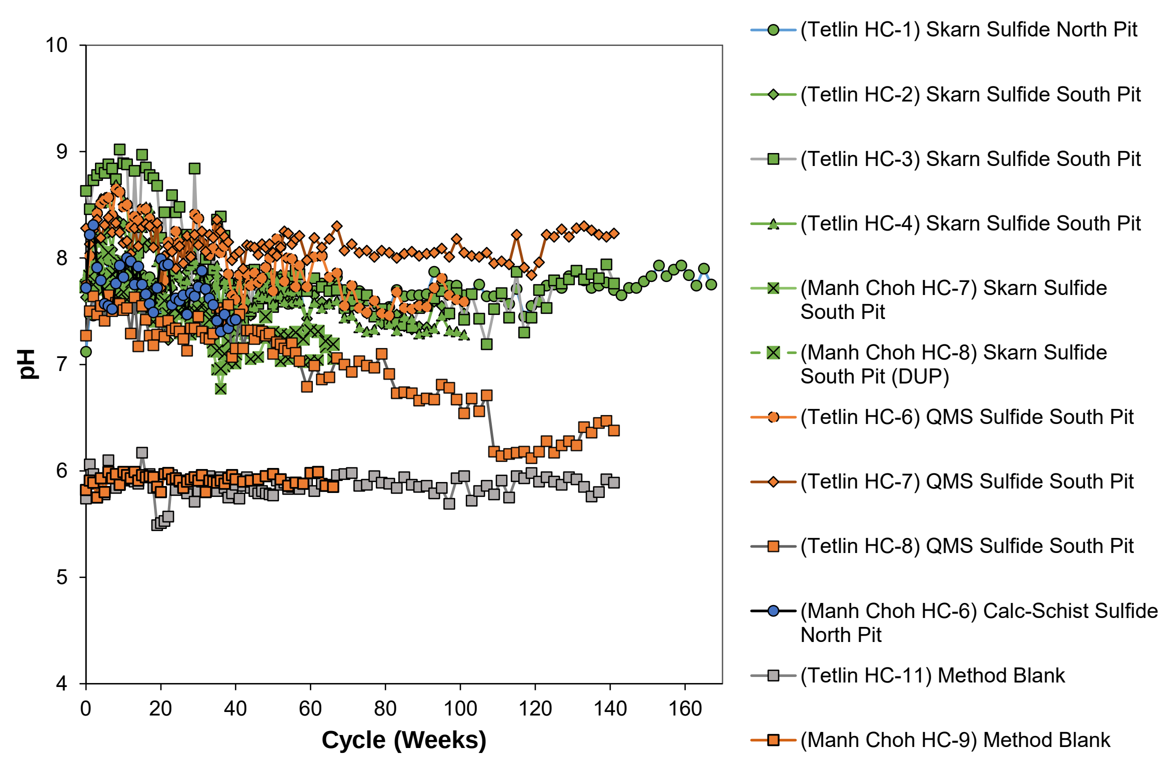

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Figure 5-8: Timeseries Plot of HCT pH for Sulfide Materials

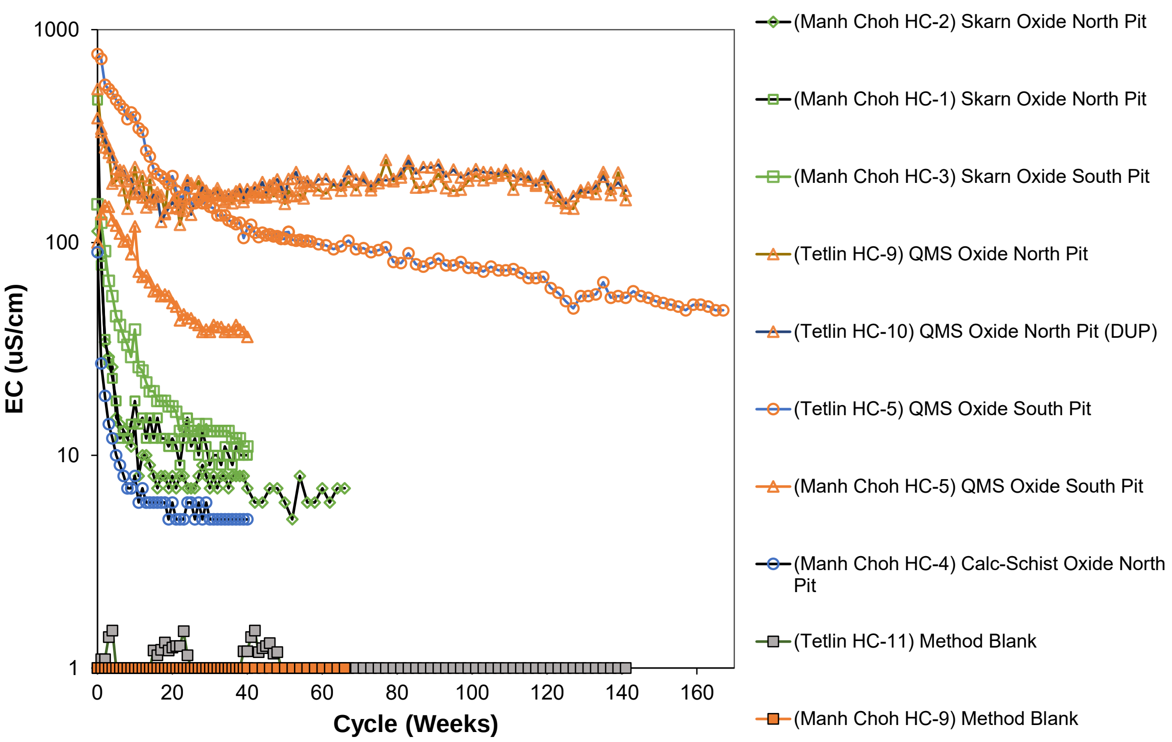

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Figure 5-9: Timeseries Plot of HCT EC for Oxide Materials

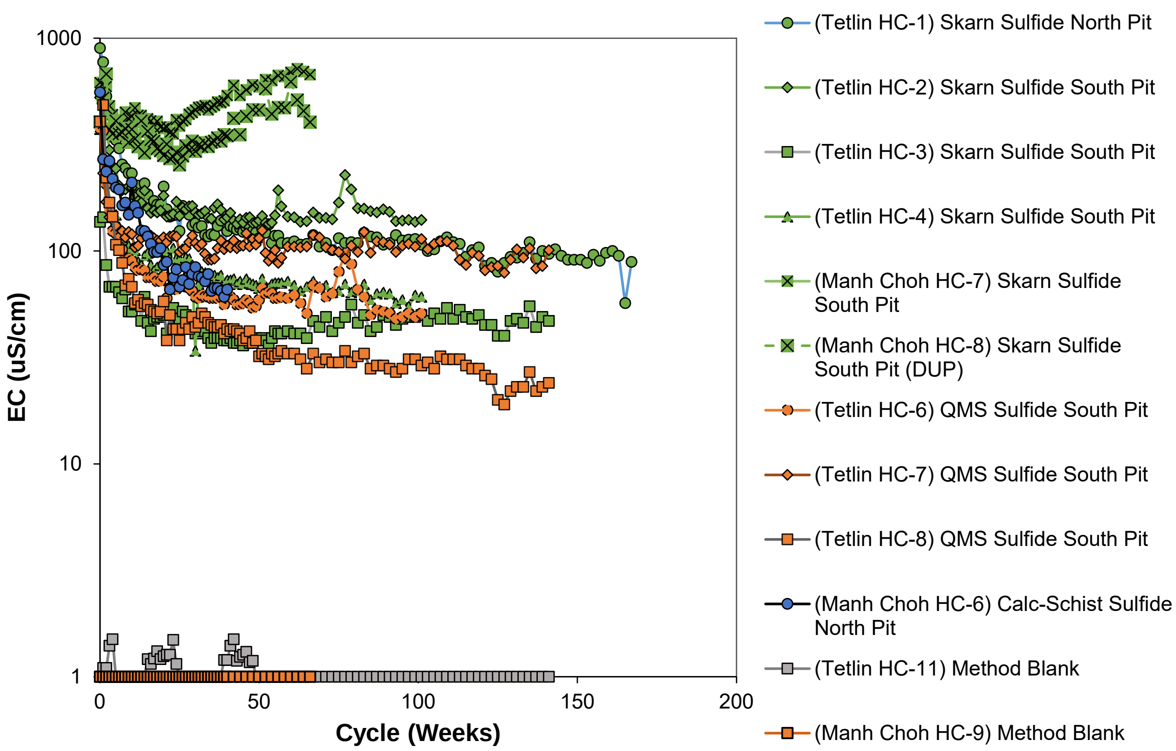

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Figure 5-10: Timeseries Plot of HCT EC for Sulfide Materials

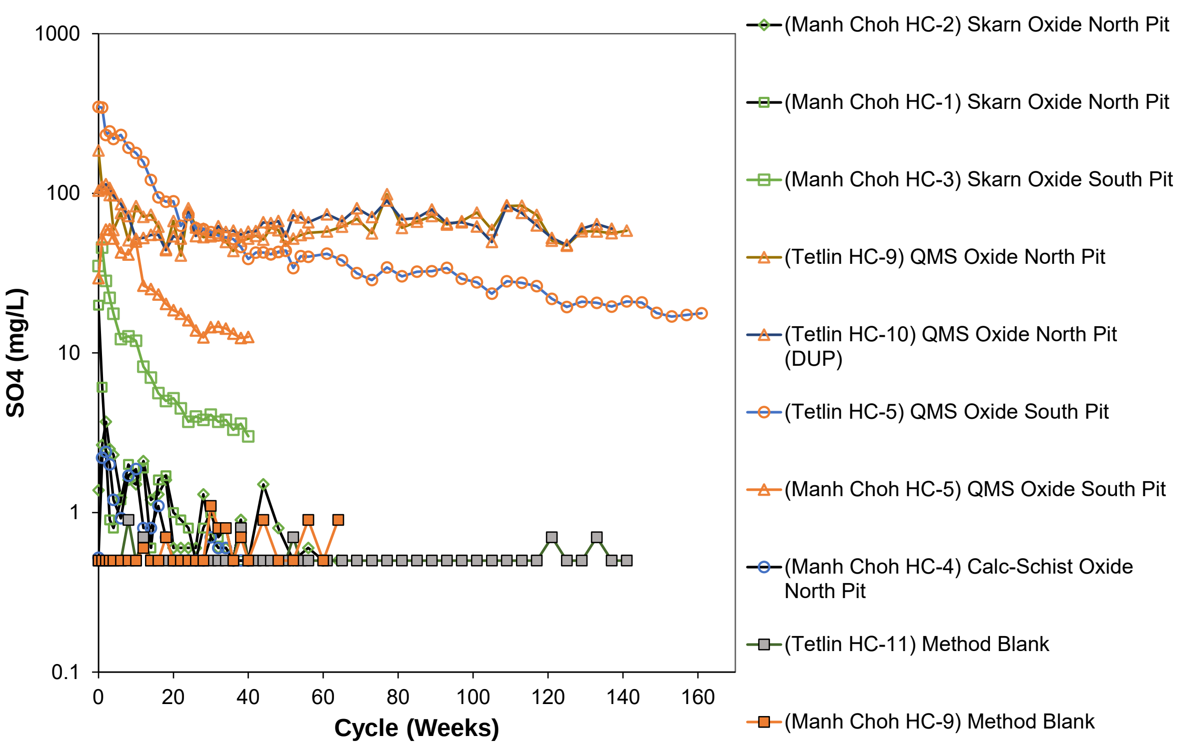

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Figure 5-11: Timeseries Plot of HCT Sulfate for Oxide Materials

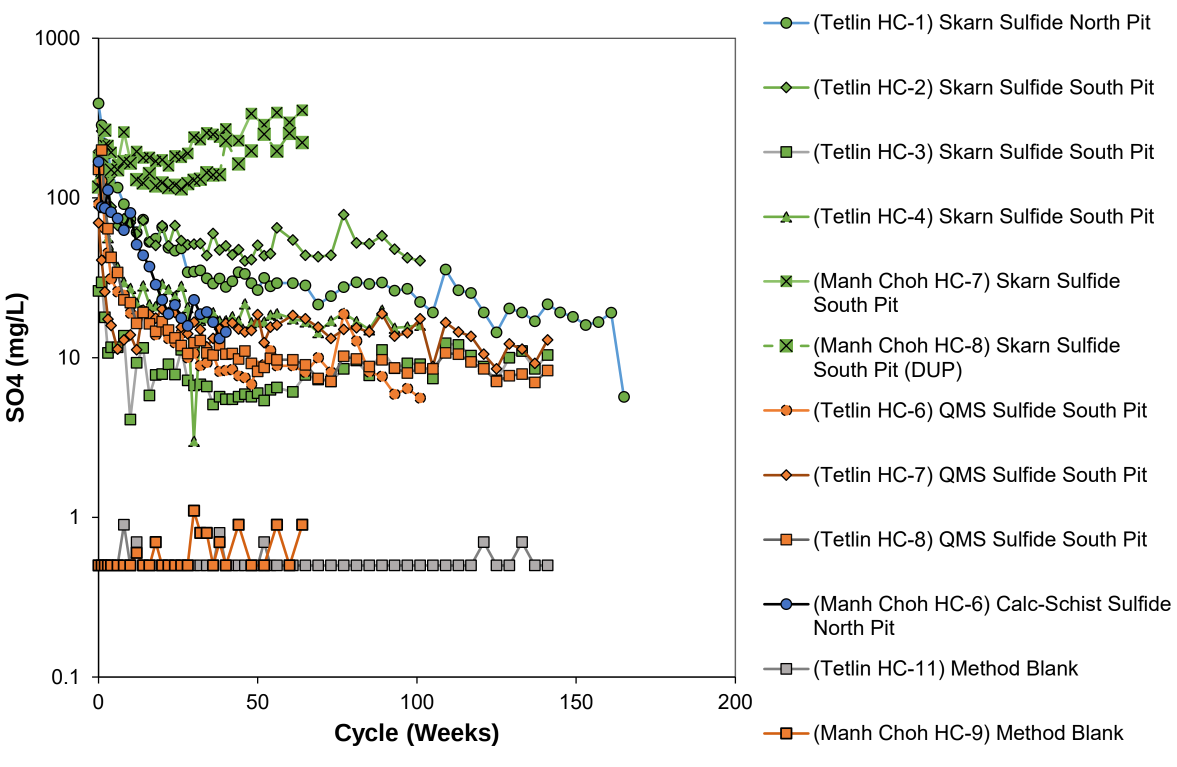

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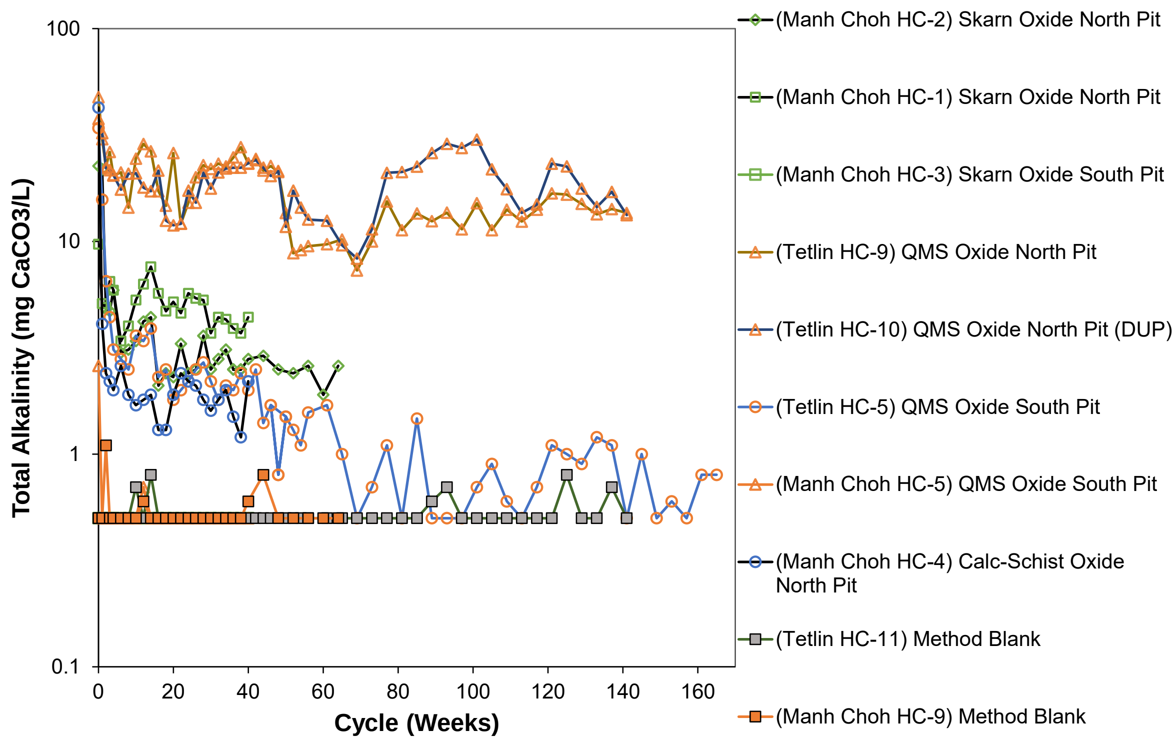
Figure 5-12: Timeseries Plot of HCT Sulfate for Sulfide Materials



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Note: The difference in alkalinity results between the duplicate samples has been cross-checked with the laboratory and no errors were detected. The laboratory has confirmed that the duplicate sample was prepared correctly by crushing, homogenizing and split-riffling. Other parameter results for the same samples have a better correlation.

Figure 5-13: Timeseries Plot of HCT Total Alkalinity for Oxide Materials

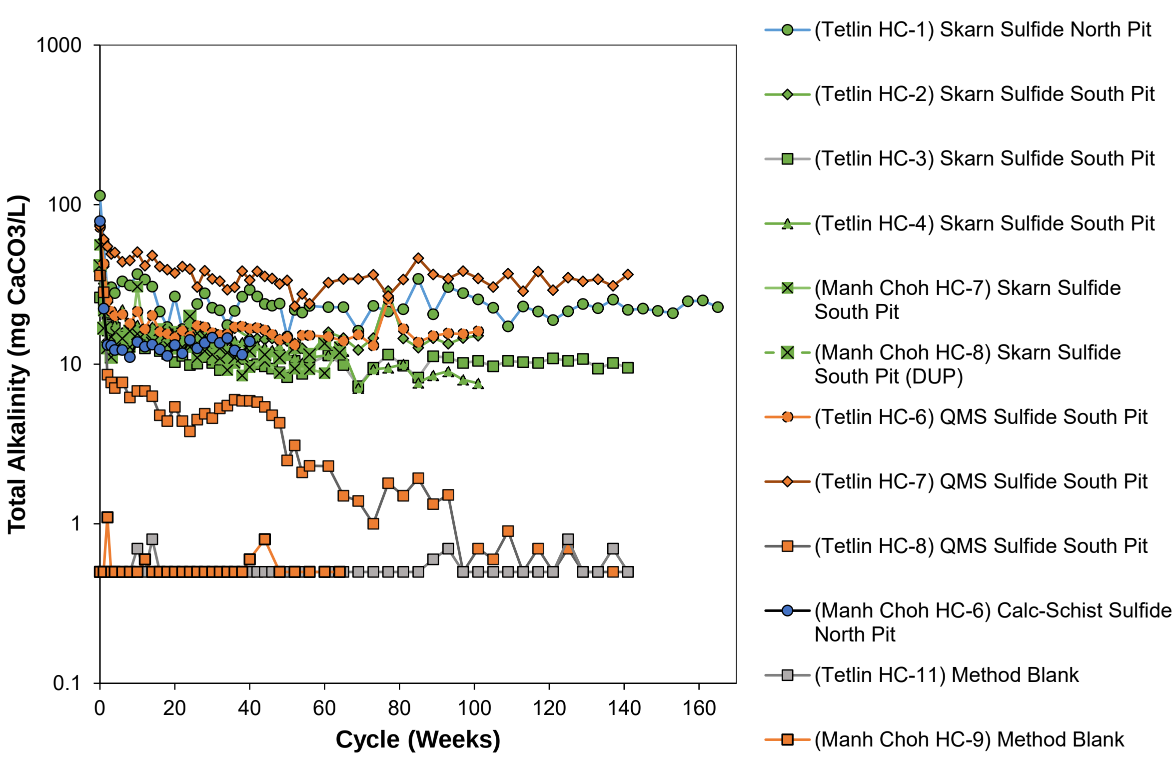

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Figure 5-14: Timeseries Plot of HCT Total Alkalinity for Sulfide Materials

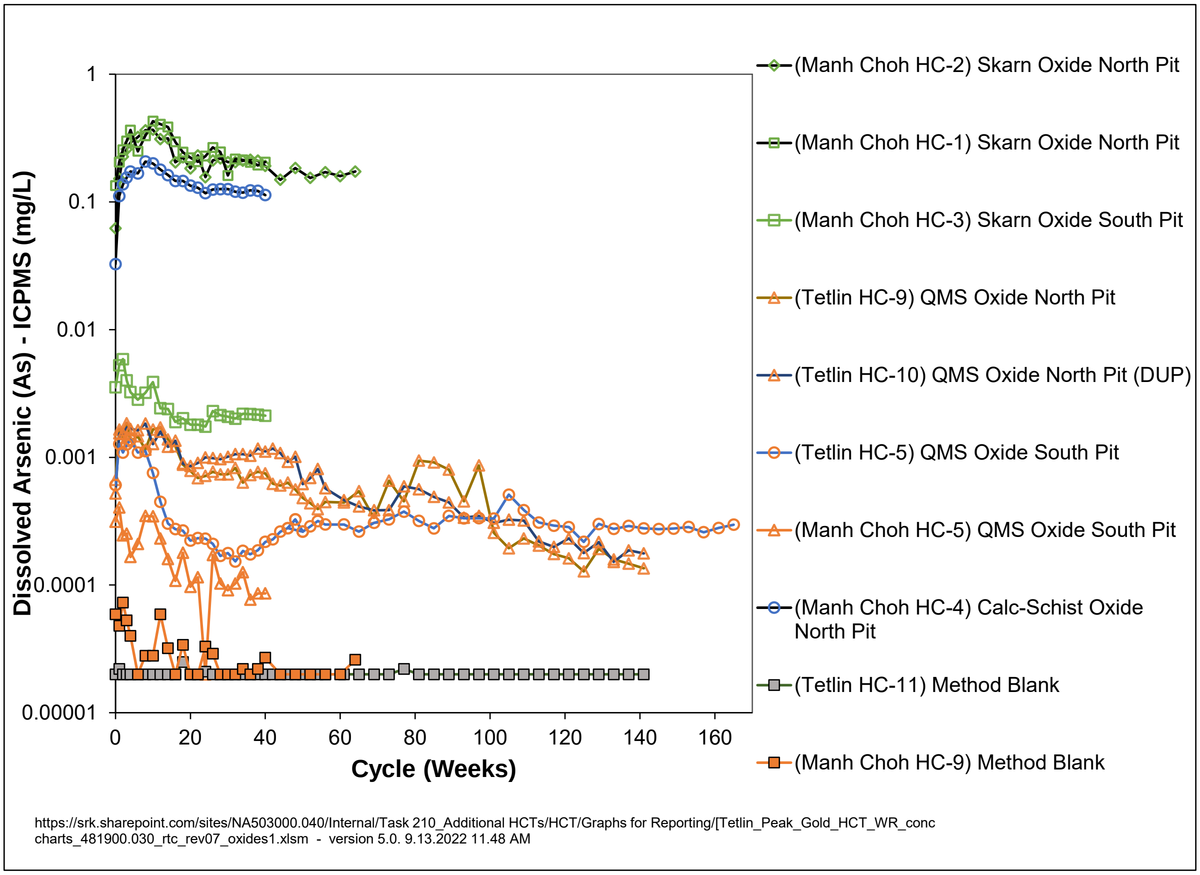

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Figure 5-15: Timeseries Plot of HCT Dissolved Arsenic Concentrations for Oxide Materials

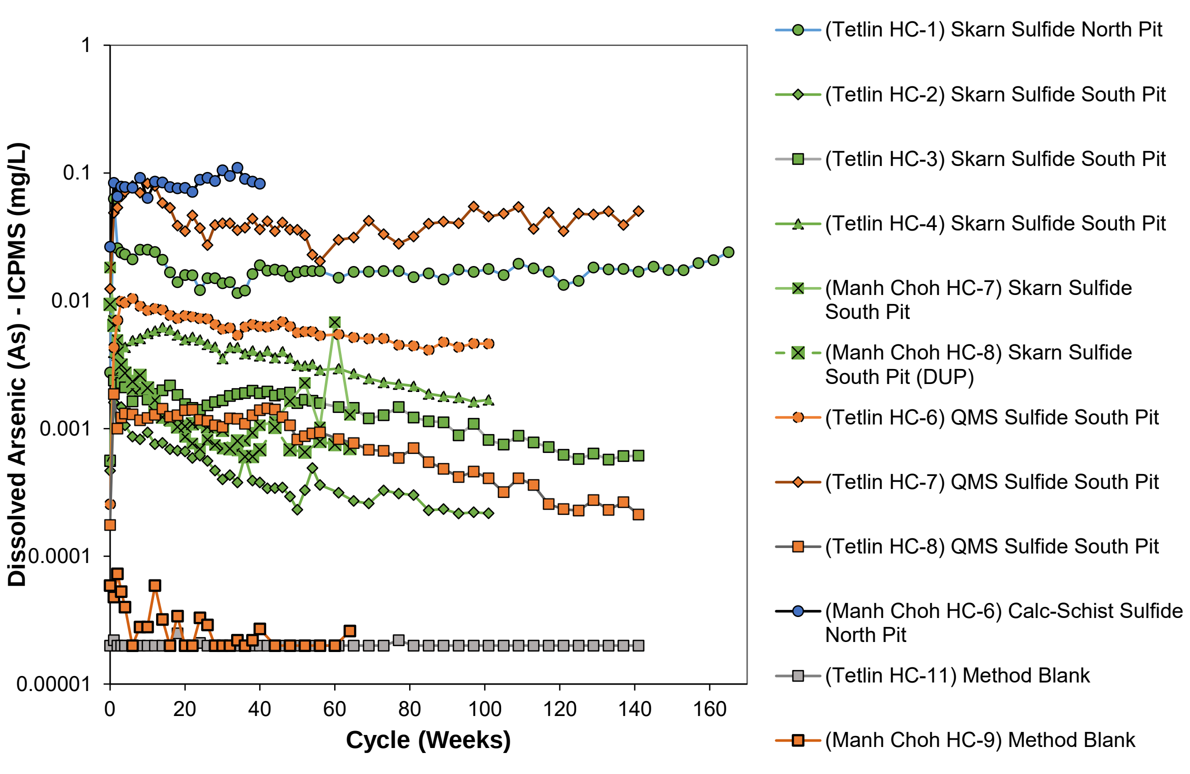

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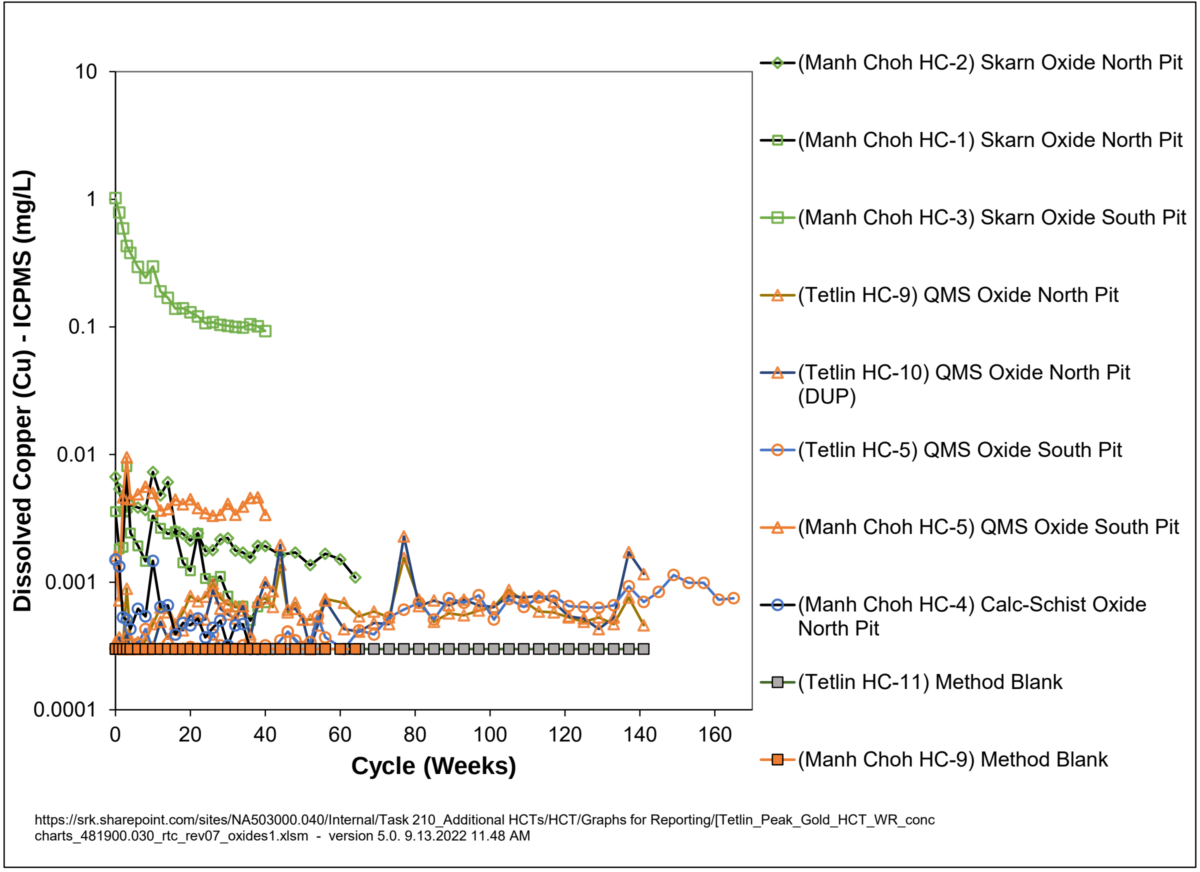
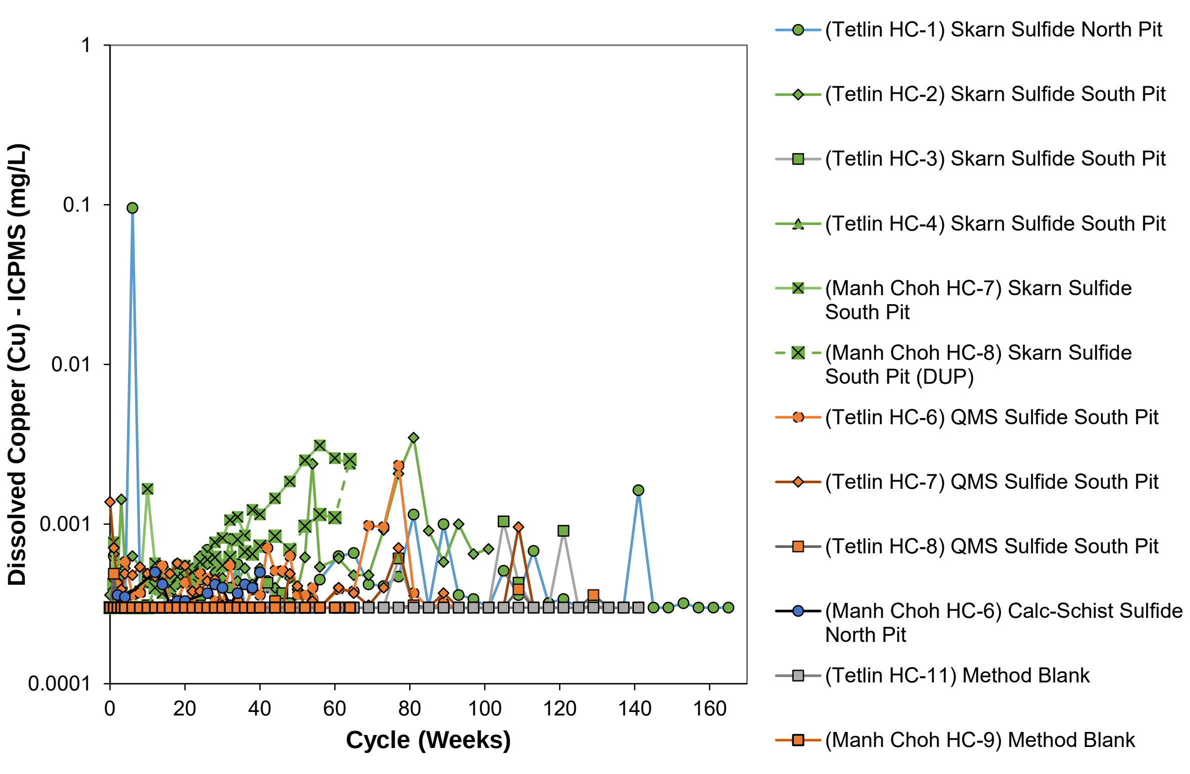
Figure 5-16: Timeseries Plot of HCT Dissolved Arsenic Concentrations for Sulfide Materials



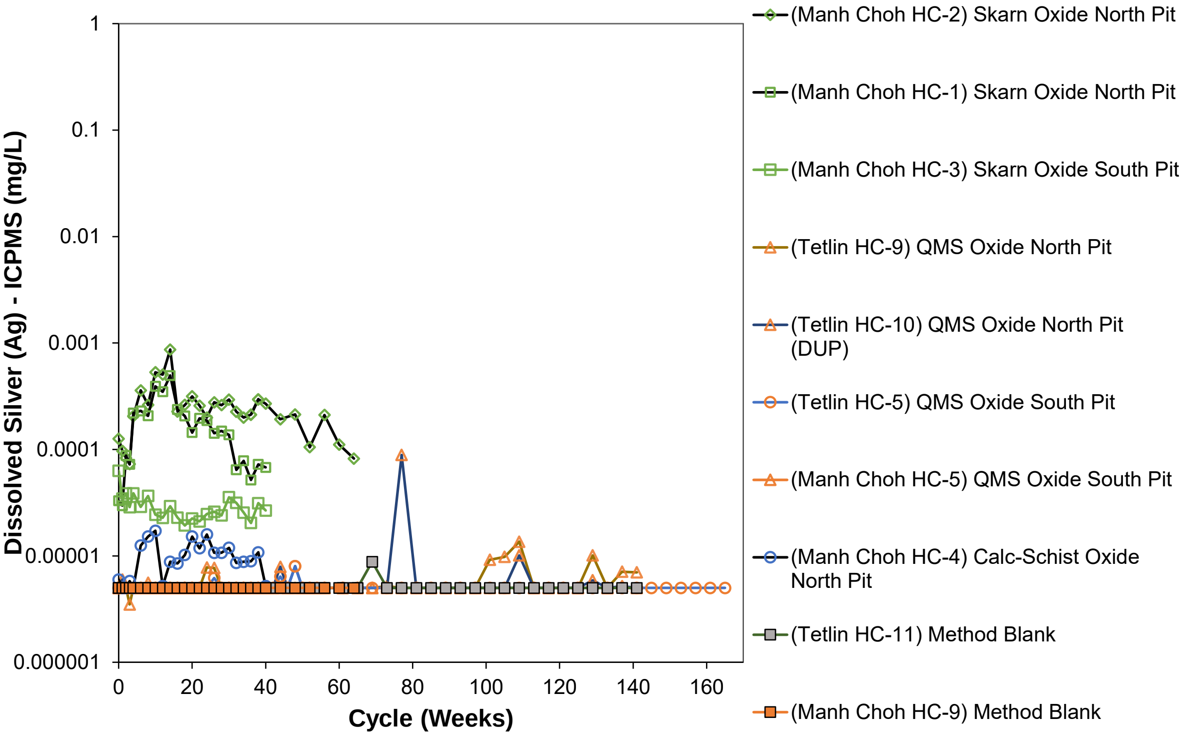
https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210_Additional HCTs/HCT/Graphs for Reporting/[Tetlin_Peak_Gold_HCT_WR_conc charts_481900.030_rtc_rev07_oxides1.xlsm - version 5.0. 9.13.2022 11.48 AM

Figure 5-17: Timeseries Plot of HCT Dissolved Copper Concentrations for Oxide Materials



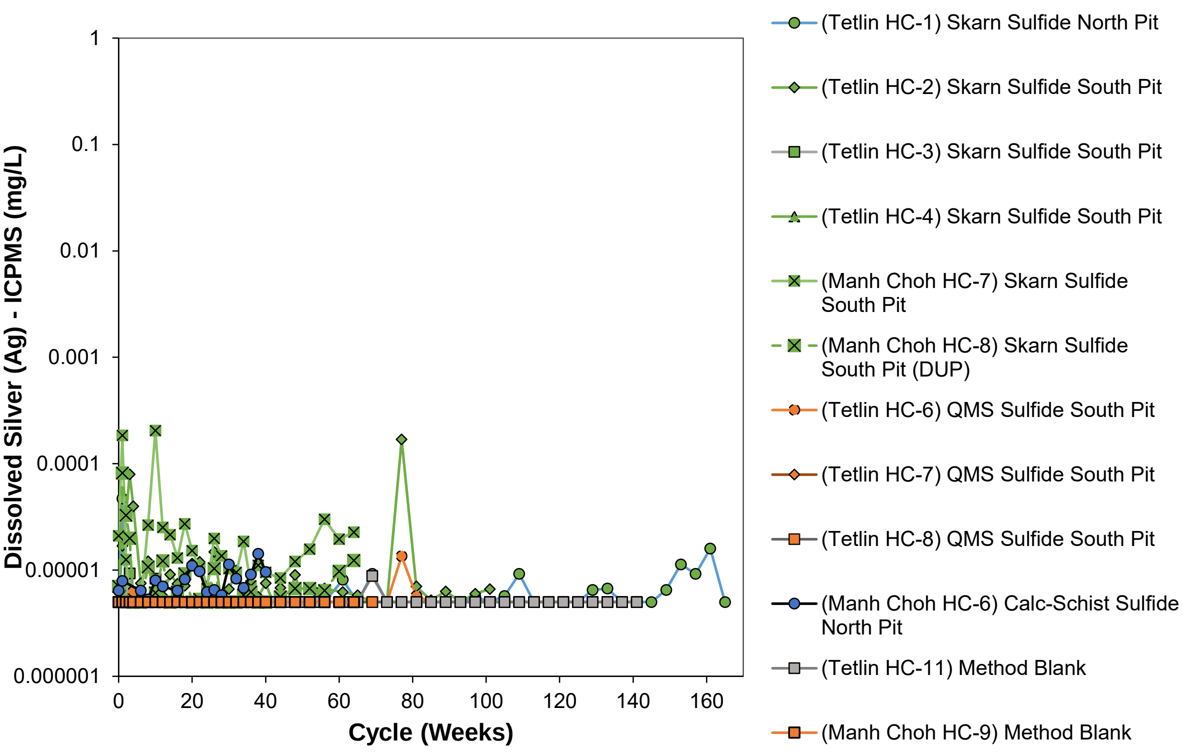
https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210_Additional HCTs/HCT/Graphs for Reporting/[Tetlin_Peak_Gold_HCT_WR_conc charts_481900.030_rtc_rev07_sulfide.xlsm

Figure 5-18: Timeseries Plot of HCT Dissolved Copper Concentrations for Sulfide Materials



https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210_Additional HCTs/HCT/Graphs for Reporting/[Tetlin_Peak_Gold_HCT_WR_conc charts_481900.030_rtc_rev07_oxides1.xlsm - version 5.0. 9.13.2022 11.48 AM

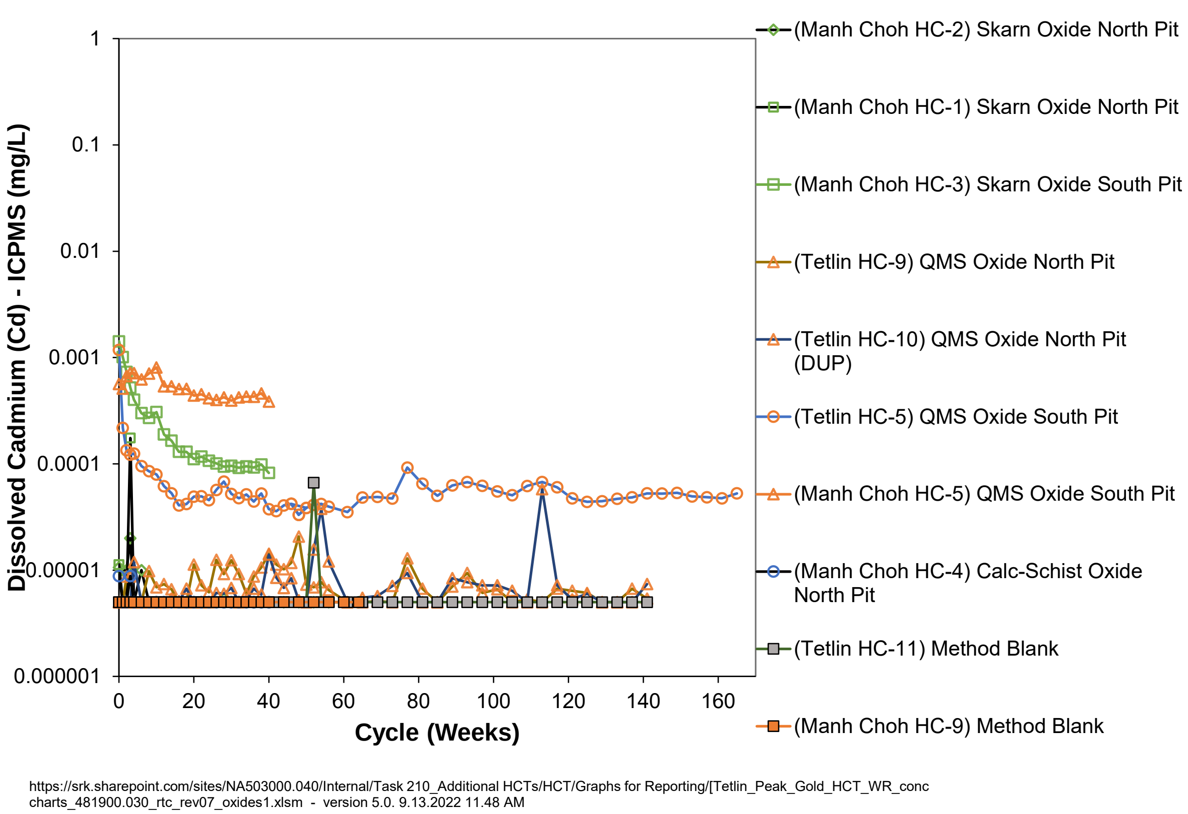
Figure 5-19: Timeseries Plot of HCT Dissolved Silver Concentrations for Oxide Materials



https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210_Additional HCTs/HCT/Graphs for Reporting/[Tetlin_Peak_Gold_HCT_WR_conc charts_481900.030_rtc_rev07_sulfide.xlsm

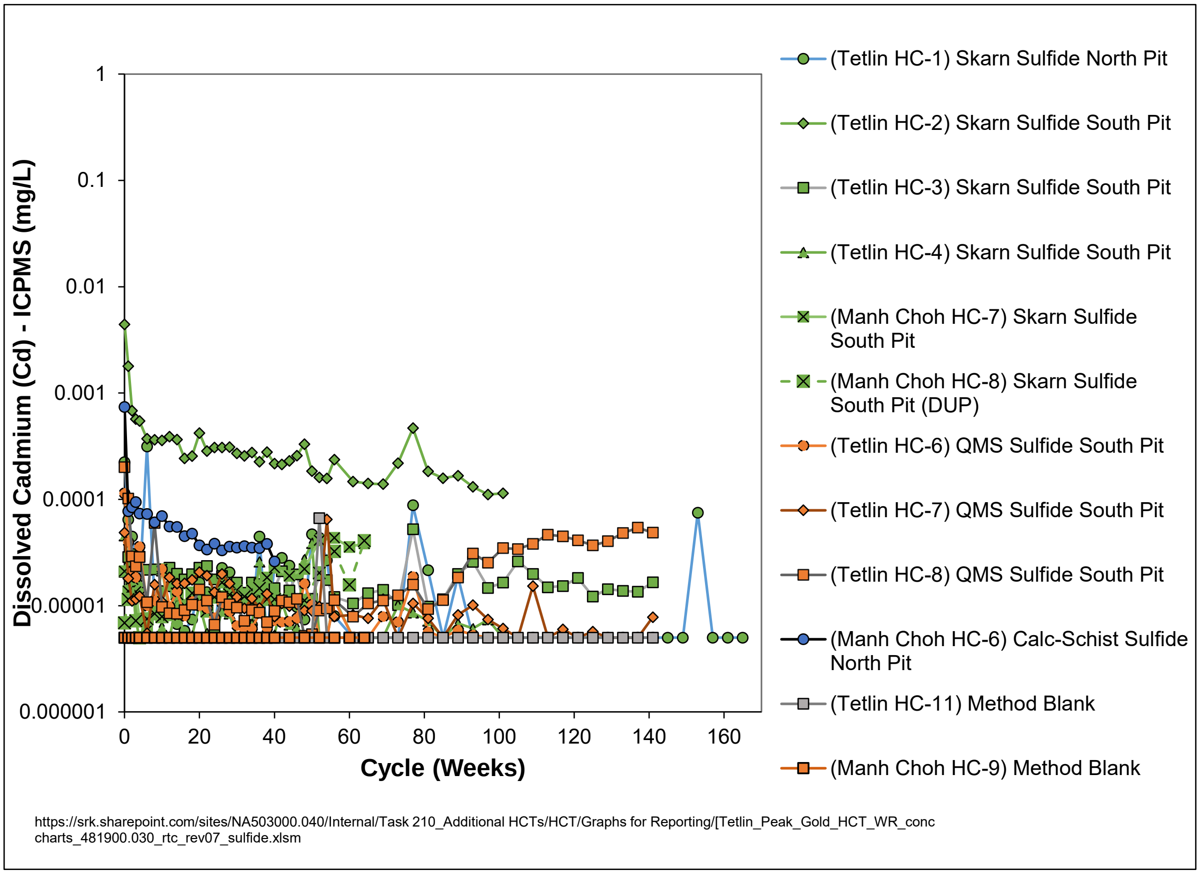
Note: The anomalous value for HC-02 at Week 77 has been rechecked with the laboratory, original concentration was reported at 0.000169 mg/L, rechecked result reported at 0.000171 mg/L.

Figure 5-20: Timeseries Plot of HCT Dissolved Silver Concentrations for Sulfide Materials



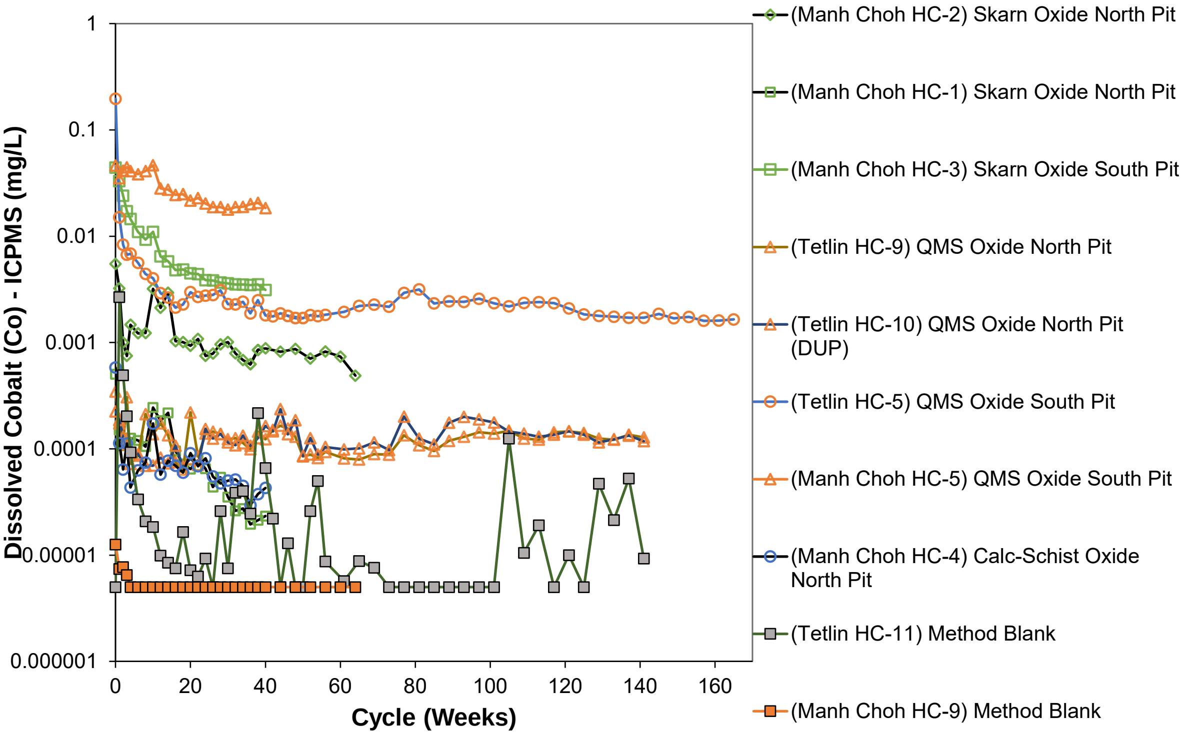
https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210_Additional HCTs/HCT/Graphs for Reporting/[Tetlin_Peak_Gold_HCT_WR_conc charts_481900.030_rtc_rev07_oxides1.xlsm - version 5.0. 9.13.2022 11.48 AM

Figure 5-21: Timeseries Plot of HCT Dissolved Cadmium Concentrations for Oxide Materials



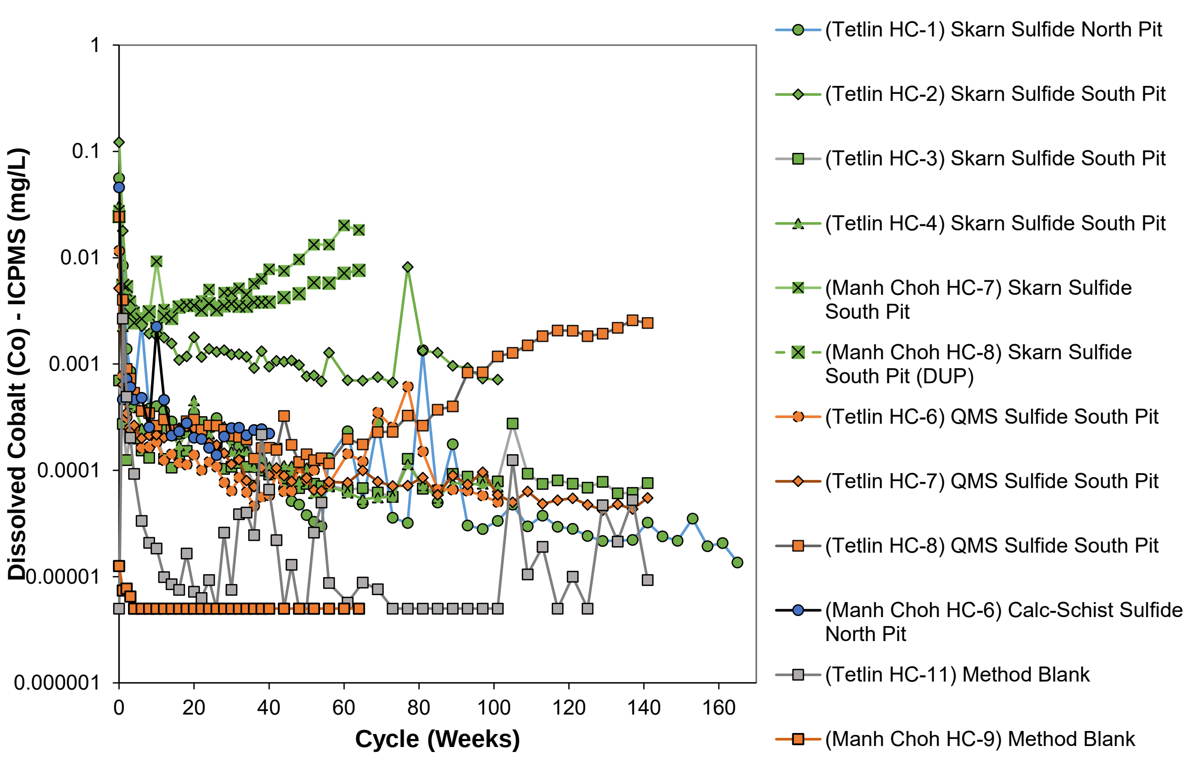
https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210_Additional HCTs/HCT/Graphs for Reporting/[Tetlin_Peak_Gold_HCT_WR_conc charts_481900.030_rtc_rev07_sulfide.xlsm

Figure 5-22: Timeseries Plot of HCT Dissolved Cadmium Concentrations for Sulfide Materials



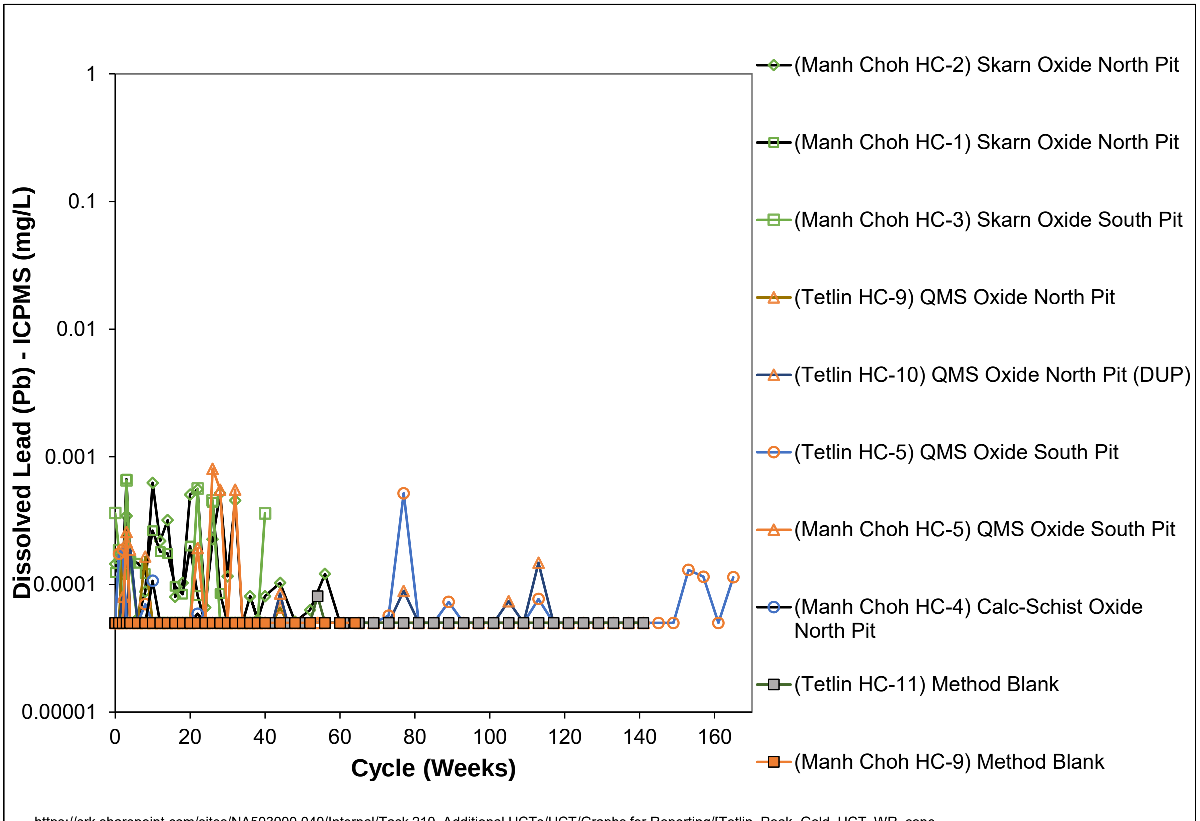
https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210_Additional HCTs/HCT/Graphs for Reporting/[Tetlin_Peak_Gold_HCT_WR_conc charts_481900.030_rtc_rev07_oxides1.xlsm - version 5.0. 9.13.2022 11.48 AM

Figure 5-23: Timeseries Plot of HCT Dissolved Cobalt Concentrations for Oxide Materials



https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210_Additional HCTs/HCT/Graphs for Reporting/[Tetlin_Peak_Gold_HCT_WR_conc charts_481900.030_rtc_rev07_sulfide.xlsm

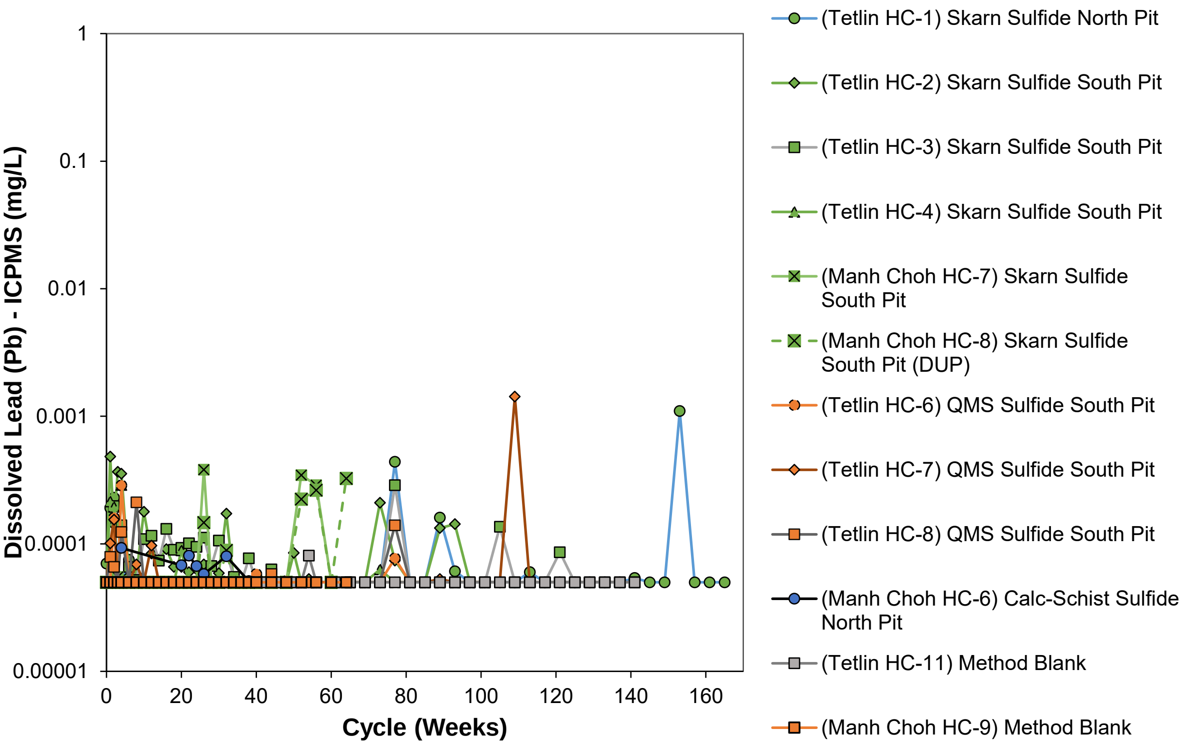
Figure 5-24: Timeseries Plot of HCT Dissolved Cobalt Concentrations for Sulfide Materials



https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210_Additional HCTs/HCT/Graphs for Reporting/[Tetlin_Peak_Gold_HCT_WR_conc charts_481900.030_rtc_rev07_oxides1.xlsm - version 5.0. 9.13.2022 11.48 AM

Note: The anomalous spike in HC-05 at Week 77 has been rechecked with the laboratory, original concentration was reported at 0.000518 mg/L, rechecked result reported at 0.0005187 mg/L.

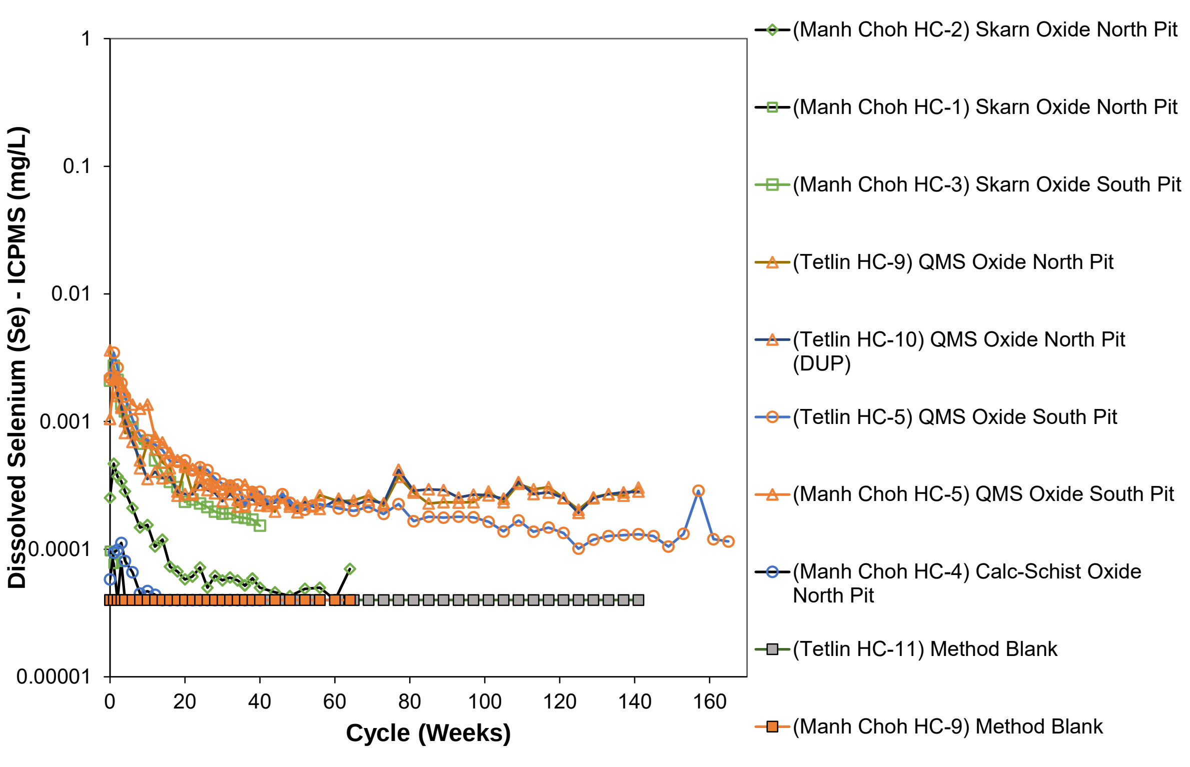
Figure 5-25: Timeseries Plot of HCT Dissolved Lead Concentrations for Oxide Materials



https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210_Additional HCTs/HCT/Graphs for Reporting/[Tetlin_Peak_Gold_HCT_WR_conc charts_481900.030_rtc_rev07_sulfide.xlsm

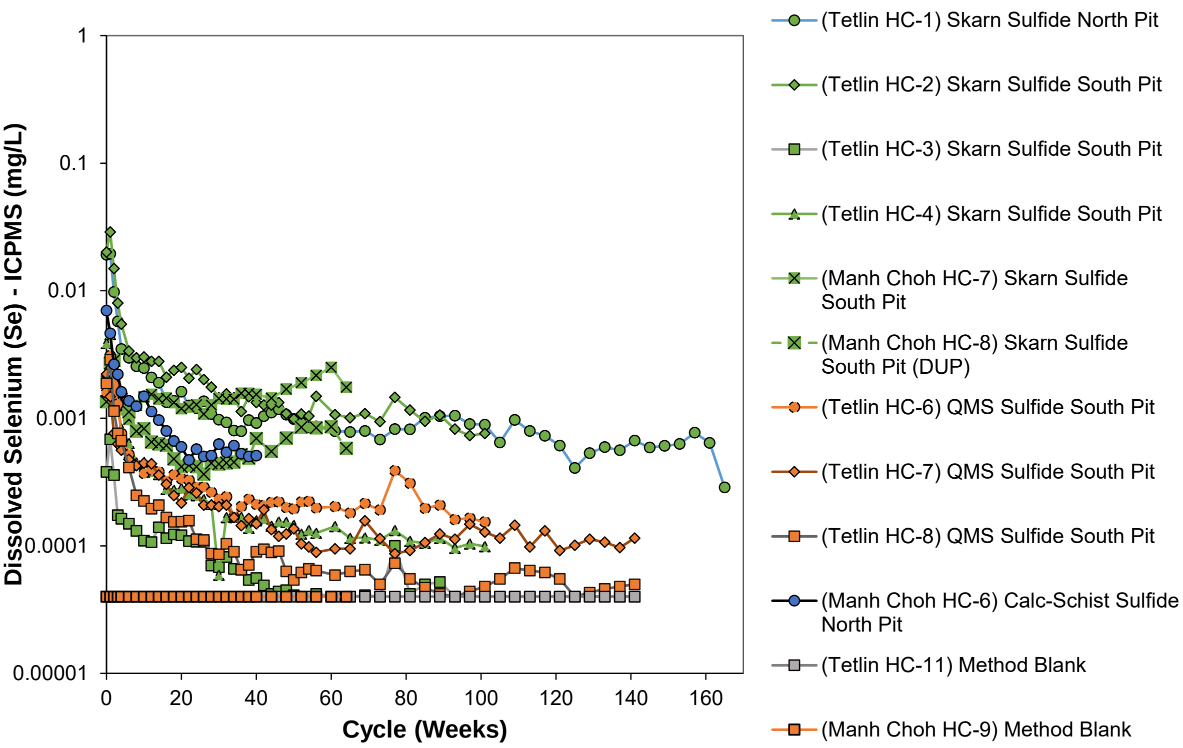
Note: The anomalous value in HC-07 at Week 109 has been rechecked with the laboratory, original concentration was reported at 0.00143 mg/L, rechecked result reported at 0.00145 mg/L. A recheck is pending on the Week 153 result for Tetlin HC-1.

Figure 5-26: Timeseries Plot of HCT Dissolved Lead Concentrations for Sulfide Materials



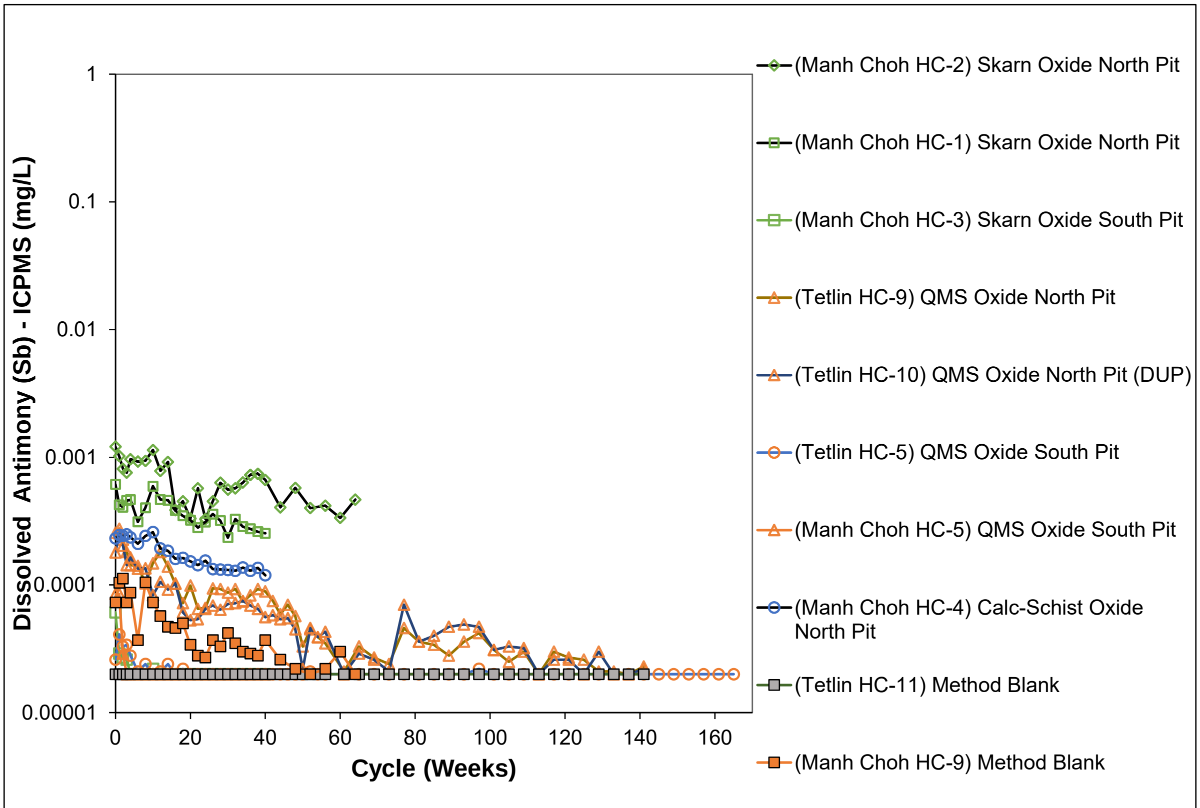
https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210_Additional HCTs/HCT/Graphs for Reporting/[Tetlin_Peak_Gold_HCT_WR_conc charts_481900.030_rtc_rev07_oxides1.xlsm - version 5.0. 9.13.2022 11.48 AM

Figure 5-27: Timeseries Plot of HCT Dissolved Selenium Concentrations for Oxide Materials



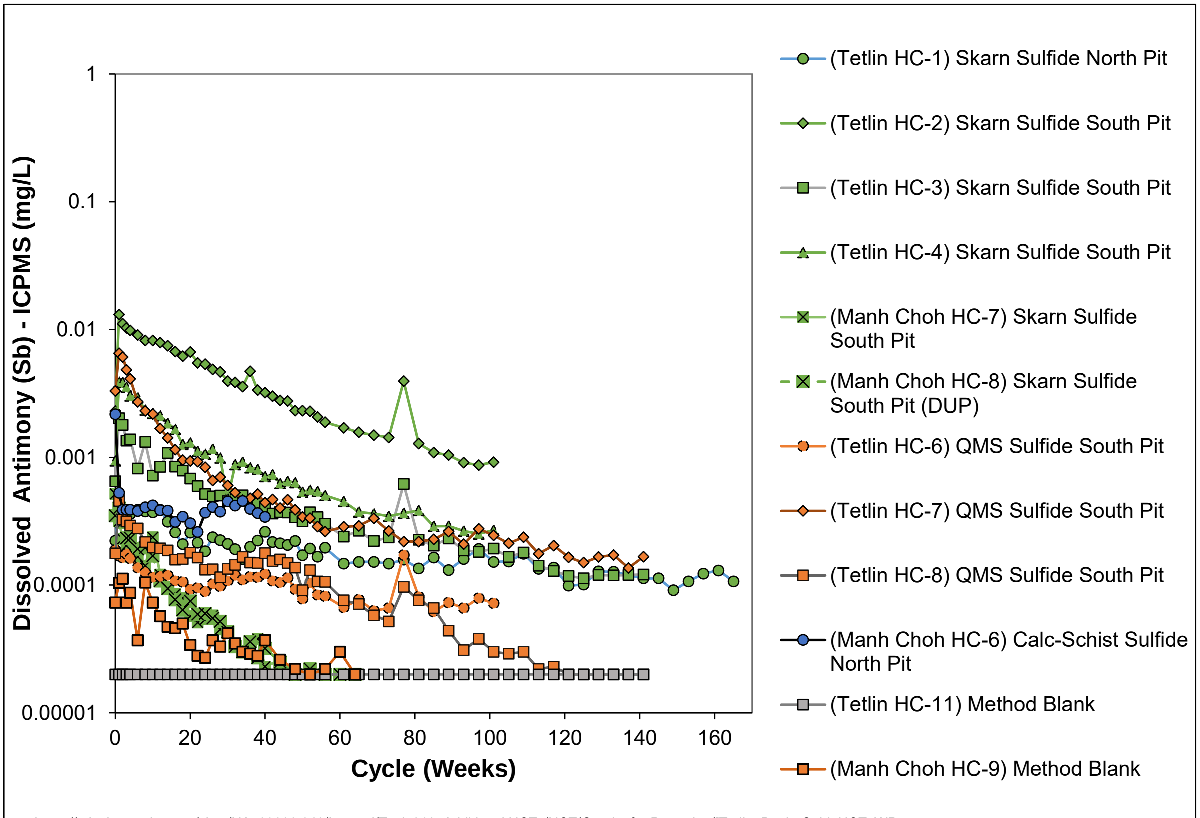
https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210_Additional HCTs/HCT/Graphs for Reporting/[Tetlin_Peak_Gold_HCT_WR_conc charts_481900.030_rtc_rev07_sulfide.xlsm

Figure 5-28: Timeseries Plot of HCT Dissolved Selenium Concentrations for Sulfide Materials



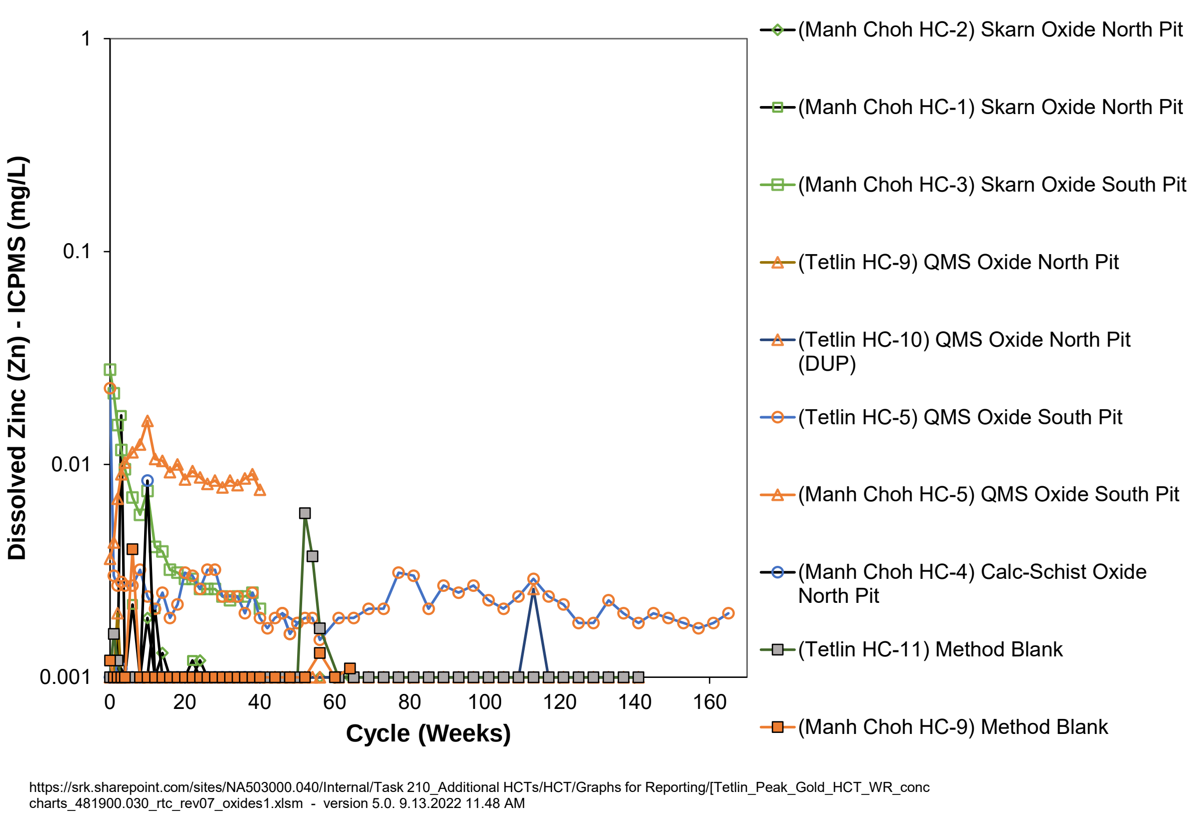
https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210_Additional HCTs/HCT/Graphs for Reporting/[Tetlin_Peak_Gold_HCT_WR_conc charts_481900.030_rtc_rev07_oxides1.xlsm - version 5.0. 9.13.2022 11.48 AM

Figure 5-29: Timeseries Plot of HCT Dissolved Antimony Concentrations for Oxide Materials



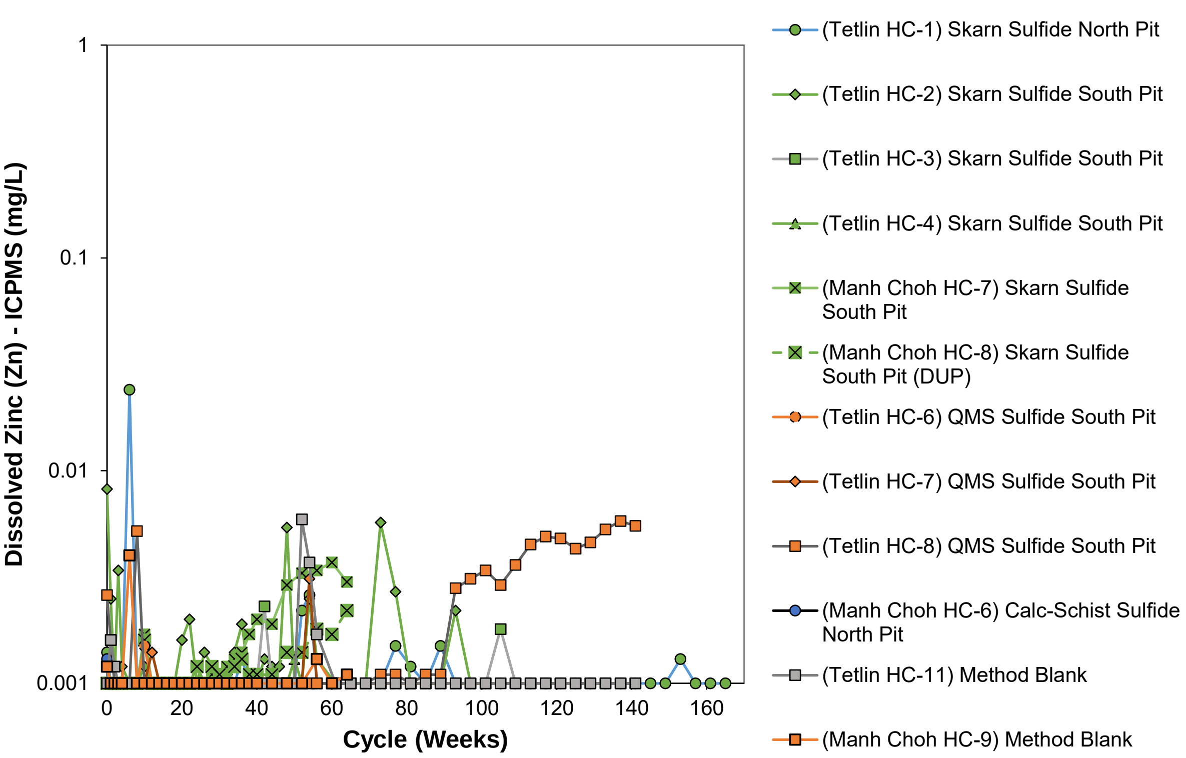
https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210_Additional HCTs/HCT/Graphs for Reporting/[Tetlin_Peak_Gold_HCT_WR_conc charts_481900.030_rtc_rev07_sulfide.xlsm

Figure 5-30: Timeseries Plot of HCT Dissolved Antimony Concentrations for Sulfide Materials



https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210_Additional HCTs/HCT/Graphs for Reporting/[Tetlin_Peak_Gold_HCT_WR_conc charts_481900.030_rtc_rev07_oxides1.xlsm - version 5.0. 9.13.2022 11.48 AM

Figure 5-31: Timeseries Plot of HCT Dissolved Zinc Concentrations for Oxide Materials



https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210_Additional HCTs/HCT/Graphs for Reporting/[Tetlin_Peak_Gold_HCT_WR_conc charts_481900.030_rtc_rev07_sulfide.xlsm

Figure 5-32: Timeseries Plot of HCT Dissolved Zinc Concentrations for Sulfide Materials

The leachates from most cells showed elevated electrical conductivity during the first five weeks of testing, corresponding to an initial flush of sulfate. The skarn sulfide (Manh Choh HC-7) and duplicate (Manh Choh HC-8) are exceptions, reporting the highest EC and increasing trends corresponding with increasing sulfate. Manh Choh HC-7 reports a maximum EC of 719 µS/cm at Week 62. Maximum sulfate in Manh Choh HC-7 was reported at 342 mg/L at Week 56 and the sulfate concentration was 297 mg/L at Week 60).

Arsenic mobilization is highest in the skarn oxides (Manh Choh HC-1, HC-2) and calc-schist oxide (Manh Choh HC-4) (Figure 5-15). Manh Choh HC-1 and HC-2 report similar trends with maximum arsenic around 0.43 mg/L at Week 10 but decreasing thereafter. Manh Choh HC-2 reports 0.16 mg/L of arsenic at Week 60. The majority of the sulfide humidity cells have reported sustained arsenic mobilization for the duration of the test (Figure 5-16). Skarn sulfide (Tetlin HC-1) has reported arsenic mobilization averaging 0.02 mg/L throughout the 161 weeks of testing. QMS sulfide (Tetlin HC-7) averaged 0.04 mg/L arsenic to Week 141 and calc-schist sulfide (Manh Choh HC-6) averaged 0.08 mg/L arsenic to Week 40.

Silver was elevated in most material types but predominantly reported an initial flush rather than sustained mobilization. Skarn oxide (Manh Choh HC-2) reported a maximum concentration of 0.9 µg/L at Week 14 but decreased to 0.1 µg/L by Week 60 (Figure 5-19). Skarn sulfide (Manh Choh HC-7) reported 0.2 µg/L at Week 10 and decreased to 0.02 µg/L by Week 60 (Figure 5-20).

Several samples reported an initial flush of cobalt but release was typically not sustained except for in the skarn sulfide cell (Manh Choh-HC-7) which reports an increasing trend to 0.02 mg/L cobalt at Week 60. Other parameters which reported elevated concentrations in some of the solid samples and showed initial flushes rather than sustained mobilization include copper, cadmium, cobalt, lead and selenium. QMS sulfide sample (Tetlin HC-8) showed an increase in zinc mobilisation between Week 89 and 137 (maximum 0.006 mg/L).

Antimony was not elevated relative to crustal abundance in the solids but did report some mobilization at neutral pH (Figure 5-29, Figure 5-30).

5.1.7 On-Site Field Barrel Tests

The onsite field barrels were commissioned in July 2022. Currently no leachate data is available from the barrels and results will be reported subsequently in update reports.

5.1.8 Waste Rock Summary

Geochemical characterization on 96 waste rock samples indicate:

- 83% of all oxide materials are classified as PAG and there is a potential for Rapid Onset PAG to develop in 35% of the QMS oxides and 68% of the skarn oxides.
- The transition and sulfide materials are not likely to generate Rapid Onset PAG but there is still potential for acid generation in the longer term; 44% of the QMS sulfides and 74% of the skarn sulfides are classified as PAG.
- The 50th percentile concentration of solid phase arsenic was more than 10 times higher than the average reference values for shale in the calc-schists and skarn oxide samples. The 95th percentile arsenic concentration was elevated across all material types. Highest concentrations occurred in the skarn oxides and sulfides.
- The 50th percentile concentration of solid phase silver was also elevated relative to reference values in the calc-schist sulfides, skarn oxides and skarn sulfides. The 95th percentile concentration of silver was elevated in everything apart from the calc-schist oxide.
- The following parameters were also elevated in at least some samples: cadmium, cobalt, copper, lead, selenium. Highest concentrations were reported in the skarn materials.
- Humidity cell testing showed some of the oxide samples had acidic leachates from the outset but these gradually trended towards higher pH thereafter. The majority of sulfide samples have remained circum-neutral but one of the QMS sulfides (Tetlin HC-8) gradually decreased to pH 6.1 at Week 117 then remained stable thereafter.
- Arsenic mobilization is occurring in all humidity cells and highest concentrations are reported in the skarn oxides and calc-schist oxide for the cells completed at Week 40 and currently running at Week 60but the sulfide materials report sustained arsenic mobilization throughout the duration of the longer-term HCTs.

5.2 Ore and Tailings

5.2.1 Mineralogy

Ore

Mineralogy was undertaken on the three ore samples before beneficiation. The results of the analysis by QEMSCAN and QXRD are presented in Table 5-3 and Table 5-4 respectively and the full mineralogy report is included in Appendix A3.

Pyrrhotite was identified as the primary sulfide mineral in the ore samples. QEMSCAN reported pyrrhotite at 4.4 wt% in the Manh Choh ore which resulted in concentrations from 0.96 to 1.4 wt% in the two blend samples. The QXRD results reported pyrrhotite at 5.2 wt% in the Manh Choh ore and

1.0 to 1.4 wt% in the two blend samples. Pyrite, chalcopyrite and arsenopyrite were also reported at concentrations ranging between 0.07 and 0.94 wt%. The acidic sulfate jarosite was present in the Manh Choh ore sample at 1.83% and resulted in concentrations of 0.23 and 0.13% in the blended ores. No other sulfates were reported.

The only carbonate mineral identified was calcite and concentrations were similar across all three ore samples ranging between 1.2 and 1.5 wt% in the QEMSCAN analysis (Table 5-3) but higher (3.7 to 4.9 wt%) in the QXRD analysis (Table 5-4). The QXRD results typically align better with the carbonate chemical analysis (Section 5.2.3).

Model percentages determined by point-counting analysis are presented in Table 5-5A for the Manh Choh Master Composite ore and Table 5-5B and C for the 20% and 30% Manh Choh blends respectively. The petrographic study identified chalcopyrite and pyrrhotite as the main sulfide minerals in all samples with chalcopyrite fragments being the most abundant. Trace amounts of pyrite and sphalerite were also identified throughout. The sulfide minerals were typically described as liberated and fresh with no significant signs of oxidation.

Tailings

Mineralogy is currently pending on the most recent Manh Choh ore detoxified tailings stream.

Table 5-3: QEMSCAN Mineralogy Results in Percent by Weight for the Ore Before Beneficiation Samples

Mineralogy	Ore - Manh Choh Master Composite	Ore - 20% Manh Choh 80% Fort Knox	Ore - 30% Manh Choh 70% Fort Knox
Chalcopyrite	0.36	0.11	0.15
Pyrite	0.94	0.43	0.17
Pyrrhotite	4.39	1.41	0.96
Arsenopyrite	0.34	0.07	0.19
Other Sulfides	0.03	0.02	0.02
Sulfide Total	**6.06**	**2.03**	**1.48**
Jarosite	1.83	0.23	0.13
Iron Oxides	6.39	2.06	1.42
Ilvaite	6.90	1.55	1.25
Quartz	29.3	29.9	31.0
Muscovite	15.5	13.5	12.2
Plagioclase Feldspar	3.66	19.7	22.7
K-Feldspar	3.72	13.7	15.2
Amphibole/Pyroxene	12.3	5.60	3.84
Chlorite	7.00	5.29	4.91
Biotite/Phlogopite	0.85	1.63	1.46
Epidote	1.28	0.87	0.89
Kaolinite	0.37	0.71	0.73
Kirschsteinite?	1.30	0.43	0.27
Calcite	1.51	1.30	1.20
Titanite/Sphene	0.75	0.59	0.61
Apatite	0.32	0.30	0.31
Others	0.90	0.54	0.52
Non-Sulfide Total	**93.9**	**98.0**	**98.5**

Source: https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 500 Tailings Characterization/Lab Results/Mineralogy/[Manh Choh_Raw Ore Mineralogy Table_Rev1.xlsx

Notes:

Chalcopyrite includes trace amounts of Bornite, Chalcocite/Covellite and Enargite/Tennantite.
Other Sulfides include Sphalerite, Galena, Cobaltite and Bismuthinite.
Iron Oxides include Iron Metals, Hematite, Goethite, Ilmenite and Magnetite.
Calcite includes trace amounts of Dolomite and Ankerite.
Others includes trace amount of Zircon, Ce-Phosphate (Monazite), and unresolved mineral species.

Table 5-4: QXRD Mineralogy Results in Percent by Weight for the Ore Before Beneficiation Samples

Mineral	Ideal Formula	Ore - Manh Choh Master Composite	Ore - 20% Manh Choh 80% Fort Knox	Ore - 30% Manh Choh 70% Fort Knox
Arsenopyrite	$FeAsS$		0.5 (?)	0.5
Biotite	$K(Mg,Fe^{2+})_3AlSi_3O_{10}(OH)_2$	3.0	2.0	2.5
Calcite	$CaCO_3$	4.9	3.8	3.7
Clinochlore	$(Mg,Fe^{2+})5Al(Si_3Al)O_{10}(OH)_8$	4.6	2.4	2.6
Ferroactinolite	$Ca_2Fe_5^{2+}Si_8O_{22}(OH)_2$	8.1	2.4	1.7
Goethite	α-$Fe^{3+}O(OH)$	3.4		
Gypsum	$CaSO_4 \cdot 2H_2O$	1.0		
Illite-Muscovite 2M1	$K_{0.65}Al_{2.0}Al_{0.65}Si_{3.35}O_{10}(OH)_{2}$- $KAl_2AlSi_3O_{10}(OH)_2$	8.6	6.9	6.5
Ilmenite	$Fe^{2+}TiO_3$	0.8 (?)		
Kaolinite	$Al_2Si_2O_5(OH)_4$	2.4	1.1	1.1
K-feldspar	$KAlSi_3O_8$	7.8	15.3	15.9
Magnetite	Fe_3O_4	0.3		
Plagioclase (albite; albite, calcian)	$NaAlSi_3O_8$ – $CaAl_2Si_2O_8$	8.6	27.9	29.7
Pyrite	FeS_2	1.3	0.4	0.2 (?)
Pyrrhotite	$Fe_{1-x}S$	5.2	1.4	1.0
Quartz	SiO_2	38.7	34.9	33.6
Stilpnomelane	$K(Fe^{2+},Mg,Fe^{3+})_8(Si,Al)_{12}(O,OH)_{27}$	0.2		0.1
Titanite	$CaTiSiO_5$	1.1	1.0 (?)	0.9 (?)
Total		**100.0**	**100.0**	**100.0**

Source: https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 500 Tailings Characterization/Lab Results/Mineralogy/[Manh Choh_Raw Ore Mineralogy Table_Rev1.xlsx

Table 5-5: Petrographic Modal Mineralogy Results for the Ore Before Beneficiation Samples

A) Ore - Manh Choh Master Composite

Mineral	Modal %
Lithic fragment (clay+quartz+iron oxide±amphibole)	26.2
Quartz	16.3
Lithic fragment (quartz±amphibole± pyrrhotite±chalcopyite±carbonate)	14.9
Iron oxide	11.4
Clay-sized material	7.4
White mica	7.4
Amphibole	6.4
Chalcopyrite	4.0
Carbonate	2.0
Biotite	1.5
Epidote	1.5
Feldspar	0.5
Magnetite	0.5
Pyrite	tr
Chlorite	tr
Sphalerite	tr
Zircon	tr

B) Ore - 20% Manh Choh 80% Fort Knox

Mineral		Modal %
Quartz		34.3
Feldspar (K-feldspar>plagioclase)[1]		20.6
Lithic fragment (clay+quartz±iron oxide)		11.8
Chlorite		8.8
Iron oxide		5.4
White mica		5.4
Lithic fragment (quartz± white mica ±chlorite ±pyrrhotite±amphibole)		5.9
Carbonate		2.9
Chalcopyrite		2.9
Amphibole		1.5
Epidote		0.5
Biotite		tr
Clay-sized material		tr
Magnetite		tr
Pyrite		tr
Rutile		tr
Sphalerite		tr

C) Ore - 30% Manh Choh 70% Fort Knox

Mineral		Modal %
Quartz		33.5
Feldspar[2]		23.7
Lithic fragment (clay+quartz+-iron oxide)		9.4
Lithic fragment (quartz± white mica±chalcopyrite± amphibole)		7.9
Chlorite		7.4
Carbonate		4.9
Iron oxide		3.0
Chalcopyrite		3.0
Amphibole		2.5
White mica		2.0
Epidote		1.5
Clay-sized material		1.0
Biotite		0.5
Magnetite		tr
Pyrite		tr
Rutile		tr
Sphalerite		tr

Source: https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 500 Tailings Characterization/Lab Results/Mineralogy/[Manh Choh_Raw Ore Mineralogy Table_Rev1.xlsx

Notes:

1.Alteration and weathering minerals noted as sericite and carbonates

2. Alteration and weathering mineral noted as white mica

5.2.2 Acid Potential

Table 5-3 presents the ABA results for the ore beneficiation samples and detoxified tailings.

Ore

Paste pH is circum-neutral in all of the ore samples; the Manh Choh Master Composite reported paste pH at 7.7 and the two blends ranged between pH 8.3 and 8.4.

Total sulfur is 2.6% in the Manh Choh ore and 0.5 to 0.8% in the two blends. Sulfide sulfur (calculated from total sulfur minus H_2O soluble sulfate) is reported at 2.5% in the Manh Choh ore and 0.5 to 0.8% in the blends.

Sulfide sulfur has been used to calculated site specific acid potential (AP*) according to the equation described in Section 5.1.2.

Tailings

The acid potential of the detoxified tailings does not alter significantly from the raw ore samples. Paste pH in one of the detoxified tailings Manh Choh Master Composites (O_2) is higher than the raw ore sample at pH 8.9; the other Manh Choh Master Composite (Air) and the tailings blend samples report paste pH between 7.9 and 8.9.

Total sulfur in the tailings is 2.8% in the Manh Choh Master Composites and 0.6 to 0.9% in the blend tailings samples. H_2O soluble sulfate is assumed to be zero in the tailings samples so sulfide sulfur (calculated from total sulfur minus H_2O soluble sulfate) is equal to total sulfur. AP* is calculated from sulfide sulfur.

Table 5-6: Summary of ABA Results and Multi-Element Analysis Ore and Detoxified Tailings Samples

Material Type	Paste pH	Total Sulfur	H_2O Soluble Sulfate	Sulfide Sulfur	Total C	TIC (% CO_2)	AP*	NP*	NP*/AP*	Ag	As	Cd	Co	Cu	Mo	Mn	Pb	Se	Sb	Zn
		(%)	(%)	(%)	(%)	(%)	(Kg $CaCO_3$/T)			ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
10 x Average Crustal Abundance>>										**0.7**	**130**	**3**	**190**	**450**	**26**	**8500**	**200**	**6**	**15**	**950**
Ore - Manh Choh Master Composite	7.7	2.6	0.1	2.5	0.5	1.7	78	39	0.5	7.2	3300	1.0	400	1600	37	890	63	11	8.0	140
Ore - 20% Manh Choh Master Composite + 80% Fort Knox Composite	8.3	0.5	0.02	0.5	0.3	1.2	16	27	1.7	1.6	680	0.2	79	320	20	560	44	2.0	3.1	68
Ore - 30% Manh Choh Master Composite + 70% Fort Knox Composite	8.4	0.8	0.04	0.8	0.3	1.2	24	27	1.1	2.4	1000	0.3	120	490	20	610	45	4.0	3.2	79
Detoxified Tailings - Manh Choh Master Composite (O_2)	8.9	2.8	0.00	2.8	0.6	2.2	88	50	0.6	2.9	3300	0.9	380	1500	40	900	59	11	6.9	140
Detoxified Tailings - 20% Manh Choh Master Composite + 80% Fort Knox Composite (Air)	8.4	0.6	0.00	0.6	0.4	1.4	19	32	1.7	0.6	750	0.2	90	300	17	560	40	3.0	2.3	71
Detoxified Tailings - 30% Manh Choh Master Composite + 70% Fort Knox Composite (Air)	8.6	0.9	0.00	0.9	0.5	1.7	27	39	1.4	1.1	1100	0.4	120	520	28	660	53	3.0	3.1	88
Detoxified Tailings - 30% Manh Choh Master Composite + 70% Fort Knox Composite (O_2)	8.9	0.9	0.00	0.9	0.4	1.4	28	32	1.1	1.0	1100	0.3	120	420	18	610	41	3.0	2.6	76
Detoxified Tailings - Manh Choh Master Composite (Air) (2022 Updated Bulk Leach)	7.9	2.8	0.00	2.8	0.7	1.9	87	43	0.5	2.6	3000	1.0	360	1300	33	860	52	10	6.6	140

Source: https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 500 Tailings Characterization/Lab Results/[4646 Enviro Results Update_Reporting_20220908_Rev3.xlsx]

Notes: Results rounded to 2 significant figures

Gray shading indicates that the result exceeds 10 average crustal abundance for sedimentary shale rocks from Price (1997).

Sulfide sulfur is calculated from total sulfur minus H_2O soluble sulfate due to the presence of pyrrhotite.

H_2O soluble sulfate not reported for detoxified tailings but assumed to be below detection limit so reported at zero.

AP*: Site specific acid potential (refer to Section 5.1.2 for definition)

NP*: Site specific neutralization potential

TIC: Total Inorganic Carbon (reported as CO_2 %)

5.2.3 Neutralization Potential

Ore

TIC (reported as CO_2%) is 1.7% in the Manh Choh ore which results in a TIC of 1.2% in both blended ore samples.

A comparison of the TIC geochemistry data with the carbonate mineralogy (Section 5.2.1) shows that the geochemistry results typically align with the QXRD mineralogy but the QEMSCAN mineralogy shows a lower carbonate content.

Tailings

The Manh Choh Master Composite tailings samples report TIC at 1.9 to 2.2% and TIC in the tailings blends ranges between 1.4 and 1.7%.

Site specific NP (NP*) was calculated using the equation discussed in Section 5.1.3.

5.2.4 Acid Rock Drainage Potential

Ore

Values of NP*/AP* were less than 2 in all of the ore samples (0.5 to 1.7), and total sulfur and sulfide sulfur were greater than 0.1% in all samples (0.5% to 2.6% and 0.5% to 2.5%, respectively). This indicates that they are classified as PAG. According to the conditions outlined in the Fort Knox Waste Management Permit (2020DB0002), all three ore samples were selected to undergo humidity cell testing according to the permit requirements (NP/AP less than 3:1).

Tailings

The detoxified tailings samples reported similar NP*/AP* values as the ore; the Manh Choh composites were 0.5 to 0.6 and the tailings blends ranged between 1.1 and 1.7. Total sulfur and sulfide sulfur were also greater than 0.1% in all of the detoxified tailings samples. On this basis, the tailings are all likely to be PAG.

5.2.5 Element Leaching Potential

Trace element concentrations for key parameters in the ore before beneficiation samples and the detoxified tailings samples are summarized in Table 5-3. The results were compared to ten times global average crustal abundance for shale (Price 1997) to screen for parameters that are elevated in rock with reference to parameters likely to be regulated in water.

The MWMP test results for key parameters are also summarized and compared to NDEP Profile II reference values in Table 5-4.

Ore

The following elements exceeded ten times reference value concentrations in one or more ore before beneficiation samples:

- Arsenic (680 top 3,300 ppm, relative to threshold of 130 ppm)
- Copper (300 to 1,600 ppm, relative to threshold of 450 ppm)
- Cobalt (79 to 400 ppm, relative to threshold of 190 ppm)
- Molybdenum (20 to 37 ppm, relative to threshold of 26 ppm)
- Silver (1.6 to 7.2 ppm, relative to threshold of 0.7 ppm)
- Selenium (2 to 11 ppm relative to threshold of 6 ppm)

Key findings of the MWMP test results on the ore samples are summarized as follows:

- pH was consistently circum-neutral (pH 7.7 to 7.8).
- Total dissolved solids in the samples ranged between 1,000 and 2,700 mg/L, relative to the Profile II reference value of 1,000 mg/L.
- Sulfate was 1,600 mg/L in the Manh Choh ore sample which resulted in a concentration ranging between 450 and 620 mg/L in the two blended ore samples. Sulfate concentrations were elevated relative to the NDEP Profile II reference value of 500 mg/L in all samples except for the blended sample 20% Manh Choh ore / 80% Fort Knox ore.
- Leachable arsenic concentrations were 0.03 mg/L in all of the ore samples, slightly elevated relative to the Profile II reference value of 0.01 mg/L.
- Manganese concentrations exceeded the Profile II reference value of 0.1 mg/L in all of the ore samples (1.4 mg/L in the Master Composite and 0.12 to 0.23 mg/L in the blends).
- Cobalt concentrations were 0.04 mg/L in the Manh Choh ore sample but below the limit of detection (<0.01 mg/L) in the two blended ore samples. There are no Profile II reference values for cobalt.
- Copper concentrations (<0.04 to <0.08 mg/L) were consistently below the Profile II reference value of 1 mg/L in all of the ore samples.
- Selenium concentrations ranged between 0.01 and 0.05 mg/L and were below the reference value of 0.05 mg/L in all samples except for the Manh Choh ore sample which reported selenium at 0.052 mg/L.

Tailings

Trace element concentrations within the detoxified tailings samples were similar to those reported in the ore. Arsenic was elevated relative to ten times global average crustal abundance in all samples (750 to 3,300 ppm). Other exceedances were also reported in one or more tailings sample for copper (300 to 1,500 ppm), cobalt (90 to 380 ppm), molybdenum (17 to 40 ppm) and selenium (3 to 11 ppm) and silver (0.6 to 2.9 ppm).

There were some notable differences in the leachability of the detoxified tailings compared with the ore samples with higher mobilization typically reported for the tailings, most likely as a result of the finer grind size. Key findings of the MWMP solutions analysis are summarized as follows (Table 5-7):

- pH was slightly higher in the tailings compared with the ore (pH 7.9 to 8.3).
- Total dissolved solids were predominantly higher in the tailings relative to the ore, ranging between 580 and 3,600 mg/L, relative to the Profile II reference value of 1,000 mg/L.
- Sulfate concentrations were also higher in the tailings samples compared to the ore. The Manh Choh Master Composite (O_2) sample reported sulfate at 2,400 mg/L, the Manh Choh Composite (Air) sample reported sulfate at 760 mg/L and the tailings blend samples ranged between 350 and 1,800 mg/L. All but one sample exceeded the NDEP Profile II reference value for sulfate (500 mg/L)
- Leachable arsenic concentrations ranged between 0.4 and 0.7 mg/L in the detox tailings samples, elevated relative to the Profile II reference value of 0.01 mg/L and typically an order of magnitude higher than that reported in the ore samples.
- Antimony concentrations were also an order of magnitude higher in the MWMP solutions for the detoxified tailings compared to the ore samples. Concentrations were consistently 0.01 mg/L relative to a Profile II screening value of 0.006 mg/L.
- Manganese concentrations exceeded the Profile II reference value of 0.1 mg/L in all of the ore samples but were lower in the detoxified tailings (<0.01 to 0.04 mg/L).
- Cobalt concentrations were an order of magnitude higher in the detoxified tailings samples (0.2 to 0.7 mg/L) than the ore samples, but no Profile II reference value exists for cobalt.

- Copper and selenium concentrations were broadly similar in the tailings samples compared with the ore and consistently below the Profile II reference values. Concentrations ranged between <0.04 and 0.1 mg/L for copper and between 0.01 and 0.03 mg/L for selenium.
- Total nitrogen was higher in the tailings samples than the ore (5.4 to 21 mg/L) and exceeded the Profile II reference value (10 mg/L) in four out of five of the tailings samples.
- WAD cyanide was only analyzed in the MWMP solution for the tailings samples due to the introduction of cyanide as part of the processing circuit. Concentrations were above the Profile II threshold (0.2 mg/L) in all samples, ranging between 0.2 and 0.7 mg/L.

5.2.6 Detoxified Tailings Solution Analysis

The detoxified tailings solution was analyzed and screened against NDEP Profile II reference values. Key parameters are summarized in Table 5-7. The detoxified tailings solutions typically reported higher concentrations than seen in the MWMP solutions indicating that tailings porewaters are likely to contain a number of deleterious elements at elevated concentrations; key findings are summarized as follows:

- pH ranged between circum-neutral to moderately alkaline (pH 7.7 to 8.7). The solution analysis for the Manh Choh Master Composite (O_2) was elevated relative to the Profile II screening value of pH 8.5.
- TDS concentrations in the tailings solutions was higher than reported for the MWMP tests, ranging between 2,500 and 8,000 mg/L relative to the Profile II screening value of 1,000 mg/L.
- Sulfate concentrations were also higher in the tailings solutions ranging between 1,400 and 4,900 mg/L relative to the Profile II screening value of 500 mg/L.
- Arsenic concentrations ranged between 1.0 and 2.8 mg/L in the tailings solutions, elevated relative to the Profile II reference value (0.01 mg/L) and MWMP concentrations.
- Antimony concentrations in the tailings solutions were similar to those reported for the tailings MWMP results (0.01 mg/L), elevated relative to the Profile II screening value of 0.006 mg/L.
- Iron concentrations were higher in the tailings solutions compared to the MWMP (<0.1 to 5.7 mg/L) relative to a Profile II value of 0.6 mg/L.
- Cobalt concentrations were higher than in the detoxified tailings MWMP solutions (1.1 to 2.7 mg/L) but no Profile II reference value exists for cobalt.
- Copper concentrations ranged between 0.3 and 11 mg/L in the tailings solutions and were only elevated relative to Profile II (1.0 mg/L) in the tailings solution for the Manh Choh Master Composite (O_2).
- Cadmium concentrations were below detection limit (<0.001 to <0.003 mg/L) in all of the tailings solutions except for the 20% Manh Choh ore blend which reported cadmium at 0.02 mg/L, exceeding the Profile II screening value of 0.005 mg/L.
- Manganese concentrations in the tailings solutions were broadly similar to those reported in the tailings MWMP tests (0.06 to 0.2 mg/L). The 20% Manh Choh ore blend sample exceeded the Profile II reference value of 0.1 mg/L.
- Total nitrogen exceeded the Profile II reference value (10 mg/L) in all samples and was approximately an order of magnitude higher in the tailings solutions to the MWMP leachates (60 to 290 mg/L).

5.2.7 Humidity Cell Tests

Humidity cell test results for key parameters are presented in Figure 5-33 to Figure 5-46 and full results are included in Appendix B2. pH is circum-neutral to moderately alkaline in the ore humidity cells (Figure 5-33). pH ranges between 7.5 and 8.2 in the Manh Choh ore sample (Kinross HC-01) and between 7.8 and 8.8 in the two ore blend samples (Kinross HC-02 and HC-03); highest pH is recorded in the 30% Manh Choh ore blend (Kinross HC-03).

There was an initial flush of EC and sulfate in all of the ore cells but these parameters show a gradually decreasing trend thereafter (Figure 5-34 and Figure 5-35). Sulfate concentrations are highest in the Manh Choh ore sample (Kinross HC-01); reported at 142 mg/L in Week 30.

Arsenic mobilisation is variable to Week 30; concentrations are highest in the 20% ore blend sample (Kinross HC-02) (Figure 5-37). A maximum arsenic concentration of 0.05 mg/L was reported in this cell during Week 16 but at Week 30 the highest concentration was 0.03 mg/L.

Some of the ore humidity cells reported an initial flush of copper but concentrations are relatively stable or only gradually increasing thereafter. Copper concentrations were highest in the Manh Choh ore sample (Kinross HC-01) at Week 30 (0.0008 mg/L) (Figure 5-38).

Cadmium and lead concentrations have fluctuated in the ore HCT leachates (Figure 5-39 and Figure 5-41). The Manh Choh ore sample (Kinross HC-01) appears to report anomalous results at Week 18 and 28 which are being reviewed by the laboratory. Cadmium concentrations in the 20% ore blend sample (Kinross HC-02) shows a gradually increasing trend to a maximum of 0.00002 mg/L at Week 30.

Concentrations of cobalt are generally stable in the Manh Choh ore (Kinross HC-01) and gradually decreasing in the two ore blends (Figure 5-40). Concentrations are notably higher in the Manh Choh ore sample (Kinross HC-01) compared to the ore blend samples and a maximum concentration of 0.003 mg/L was reported at Week 28). Concentrations of manganese are also higher in the Manh Choh ore (Kinross HC-01) (Figure 5-44) compared to the other ore blends.

Concentrations of selenium, antimony and molybdenum all show decreasing trends (Figure 5 42, Figure 5 43 and Figure 5 45 respectively) and zinc is consistently reported at detection limit (Figure 5 46).

Table 5-7: Summary of MWMP Results for Ore Samples Used in Metallurgical Test Work

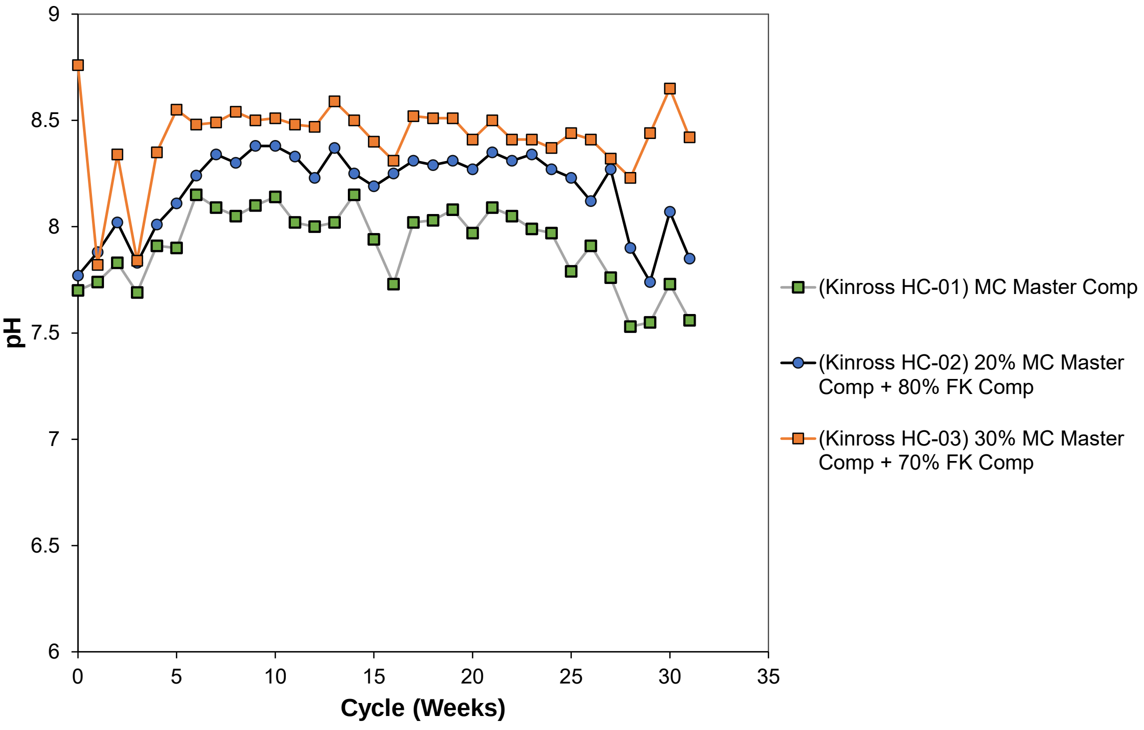
Material Type	pH	TDS	Alkalinity, $CaCO_3$	CO_3, $CaCO_3$	HCO_3	SO_4	Total N	Sb	As	Cd	Co	Cu	WAD CN	Fe	Pb	Mn	Hg	Mo	Ni	Se	Ag	Na	Zn
	s.u.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
NDEP Profile II Reference Values>>	**6.5-8.5**	**1,000**	**--**	**--**	**--**	**500**	**10**	**0.006**	**0.01**	**0.005**	**--**	**1**	**0.2**	**0.6**	**0.015**	**0.1**	**0.002**	**--**	**--**	**0.05**	**0.1**	**--**	**5.0**
Ore - Manh Choh Master Composite	7.7	2,700	120	<1.0	120	1,600	<1.4	<0.003	0.03	<0.002	0.04	<0.08	--	<0.20	<0.003	1.4	<0.0005	<0.04	<0.05	0.05	<0.01	18	<0.04
Ore - 20% Manh Choh Master Composite + 80% Fort Knox Composite	7.8	1,000	75	<1.0	75	450	5.9	0.003	0.03	<0.001	<0.01	<0.04	--	<0.10	<0.003	0.1	<0.0005	0.6	<0.03	0.01	<0.005	150	<0.02
Ore - 30% Manh Choh Master Composite + 70% Fort Knox Composite	7.8	1,300	85	<1.0	85	620	5.2	<0.003	0.03	<0.001	<0.01	<0.04	--	0.2	<0.003	0.2	<0.0005	0.3	<0.03	0.02	<0.005	140	<0.02
Detoxified Tailings - Manh Choh Master Composite (O_2)	8.0	3,600	98	20	98	2,400	21	0.01	0.7	<0.001	0.7	<0.04	0.7	0.3	<0.003	0.04	0.002	0.05	<0.03	0.03	<0.005	770	<0.02
Detoxified Tailings - 20% Manh Choh Master Composite + 80% Fort Knox Composite (Air)	8.0	580	70	<1.0	70	350	5.4	0.01	0.5	<0.001	0.2	0.1	0.2	0.3	<0.003	<0.01	<0.0005	0.1	0.1	0.01	<0.005	140	<0.02
Detoxified Tailings - 30% Manh Choh Master Composite + 70% Fort Knox Composite (Air)	7.9	3,100	67	<1.0	67	1,800	17	0.01	0.4	<0.001	0.3	<0.04	0.2	0.3	<0.003	0.04	<0.0005	0.2	<0.03	0.02	<0.005	560	<0.02
Detoxified Tailings - 30% Manh Choh Master Composite + 70% Fort Knox Composite (O_2)	8.3	1,900	70	<1.0	62	1,000	15	0.01	0.6	<0.001	0.3	<0.04	0.4	0.4	<0.003	0.02	<0.0005	0.2	<0.03	0.02	<0.005	380	<0.02
Detoxified Tailings - Manh Choh Master Composite (Air) (2022 Updated Bulk Leach)	7.9	1,500	73	<1.0	73	760	11	0.01	0.7	<0.001	0.5	<0.04	0.2	0.5	<0.003	0.01	<0.0005	0.04	<0.03	0.03	<0.005	200	<0.02

Source: https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 500 Tailings Characterization/Lab Results/[4646 Enviro Results Update_Reporting_20220908_Rev3.xlsx]
Note: Gray shading indicates that the result exceeds NDEP Profile II Reference Value.

Table 5-8: Summary of Detoxified Tailings Solution Analysis

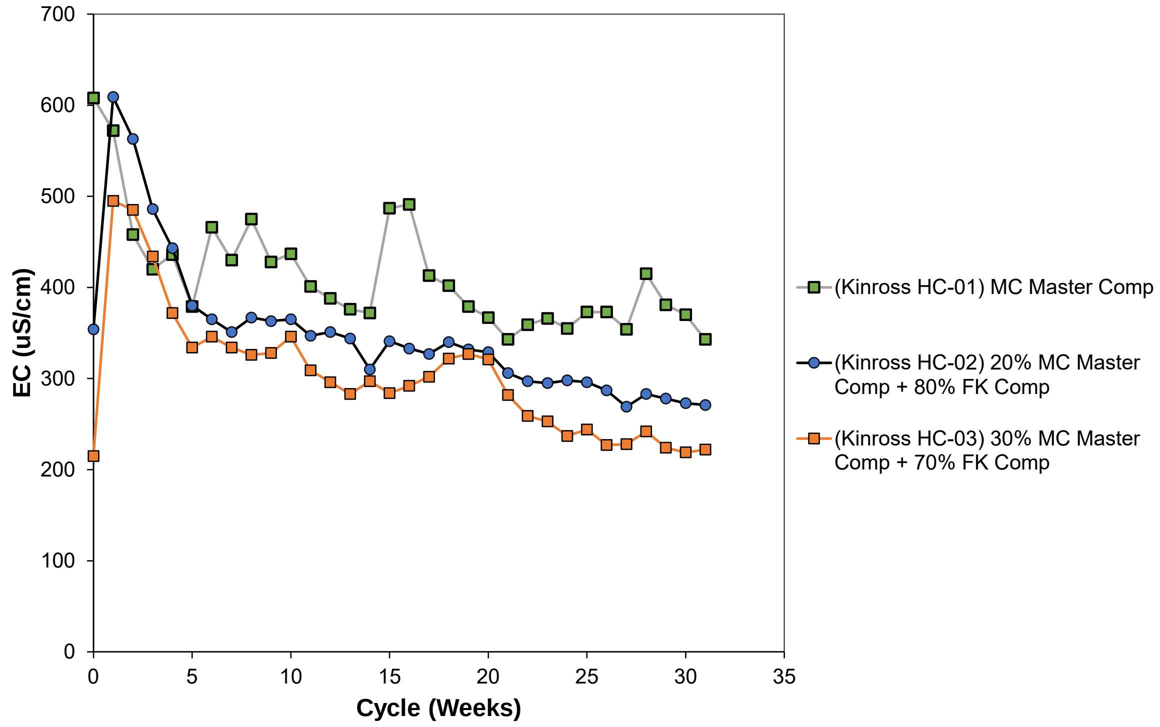
Material Type	pH	TDS	Alkalinity, $CaCO_3$	CO_3, $CaCO_3$	HCO_3	SO_4	Total N	Sb	As	Cd	Co	Cu	WAD_CN	Fe	Pb	Hg	Mn	Mo	Ni	Ag	Na	Tl	Zn
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Profile II Reference Values>>	**6.5 - 8.5**	**1000**	**--**	**--**	**--**	**500**	**10**	**0.006**	**0.01**	**0.005**	**--**	**1.0**	**0.2**	**0.6**	**0.015**	**0.002**	**0.1**	**--**	**--**	**0.1**	**--**	**0.002**	**5.0**
Manh Choh Master Composite (O_2)	8.7	8000	230	20	210	4900	290	0.01	2.7	<0.003	2.7	11	0.7	5.7	<0.005	0.001	0.06	0.2	0.1	<0.03	2200	0.004	<0.1
20% Manh Choh Master Composite + 80% Fort Knox Composite (Air)	8.2	2500	64	<1.0	64	1400	60	0.01	1.0	0.02	1.5	1.0	2.4	1.0	<0.003	<0.0005	0.17	1.0	0.2	<0.01	600	0.002	<0.04
30% Manh Choh Master Composite + 70% Fort Knox Composite (Air)	8.2	5400	120	<1.0	120	3200	120	0.01	1.3	<0.003	1.1	0.3	0.7	1.0	<0.005	<0.0005	0.07	0.8	<0.05	<0.03	1300	<0.001	<0.1
30% Manh Choh Master Composite + 70% Fort Knox Composite (O_2)	7.9	4200	110	<1.0	110	2400	120	0.01	2.8	<0.001	1.5	0.4	--	<0.10	<0.003	<0.0005	0.09	0.8	<0.03	<0.005	1300	0.002	<0.02
Detoxified Tailings - Manh Choh Master Composite (Air) (2022 Updated Bulk Leach)	7.7	4300	62	<1.0	62	2300	140	0.01	1.6	0.003	1.9	0.2	0.7	3.1	<0.005	<0.0005	0.02	0.2	0.05	<0.005	770	<0.001	<0.02

Source: https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 500 Tailings Characterization/Lab Results/[4646 Enviro Results Update_Reporting_20220908_Rev3.xlsx]
Note: Gray shading indicates that the result exceeds NDEP Profile II Reference Value.



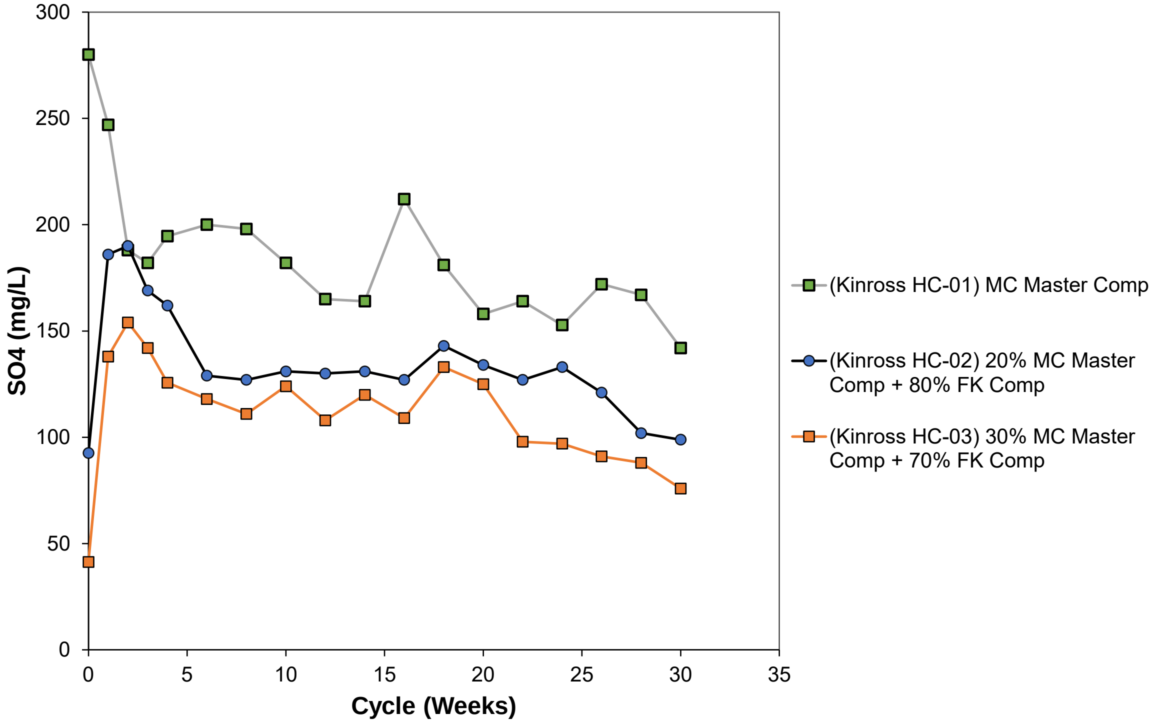
https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210_Additional HCTs/HCT/[Tetlin_Peak_Gold_HCT_Ore_conc charts_481900.030_rtc_rev01.xlsm

Figure 5-33: Timeseries Plot of HCT pH for Ore Samples



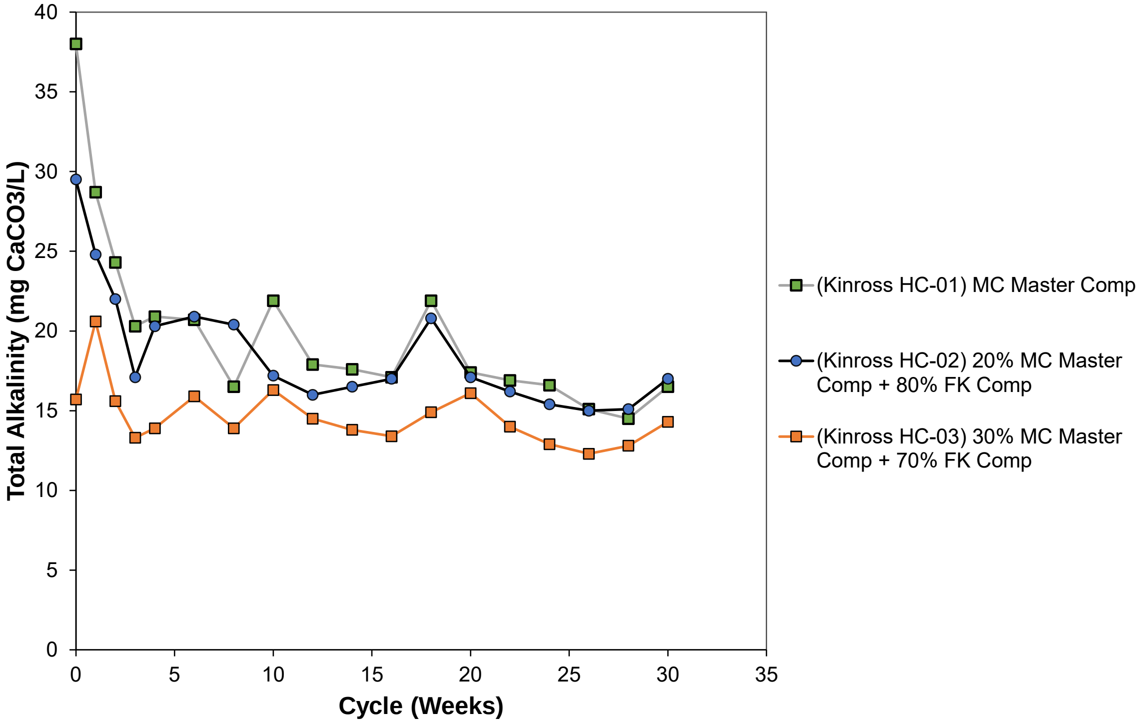
https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210_Additional HCTs/HCT/[Tetlin_Peak_Gold_HCT_Ore_conc charts_481900.030_rtc_rev01.xlsm

Figure 5-34: Timeseries Plot of HCT EC for Ore Samples



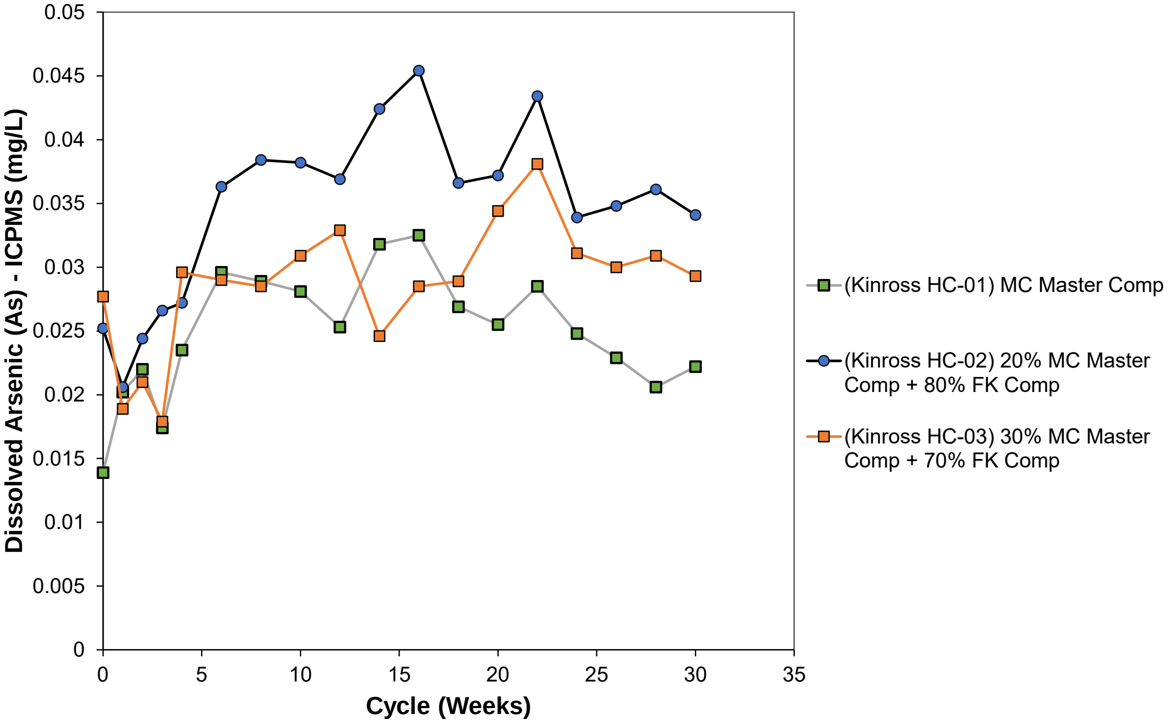
https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210_Additional HCTs/HCT/[Tetlin_Peak_Gold_HCT_Ore_conc charts_481900.030_rtc_rev01.xlsm

Figure 5-35:Timeseries Plot of HCT Sulfate for Ore Samples



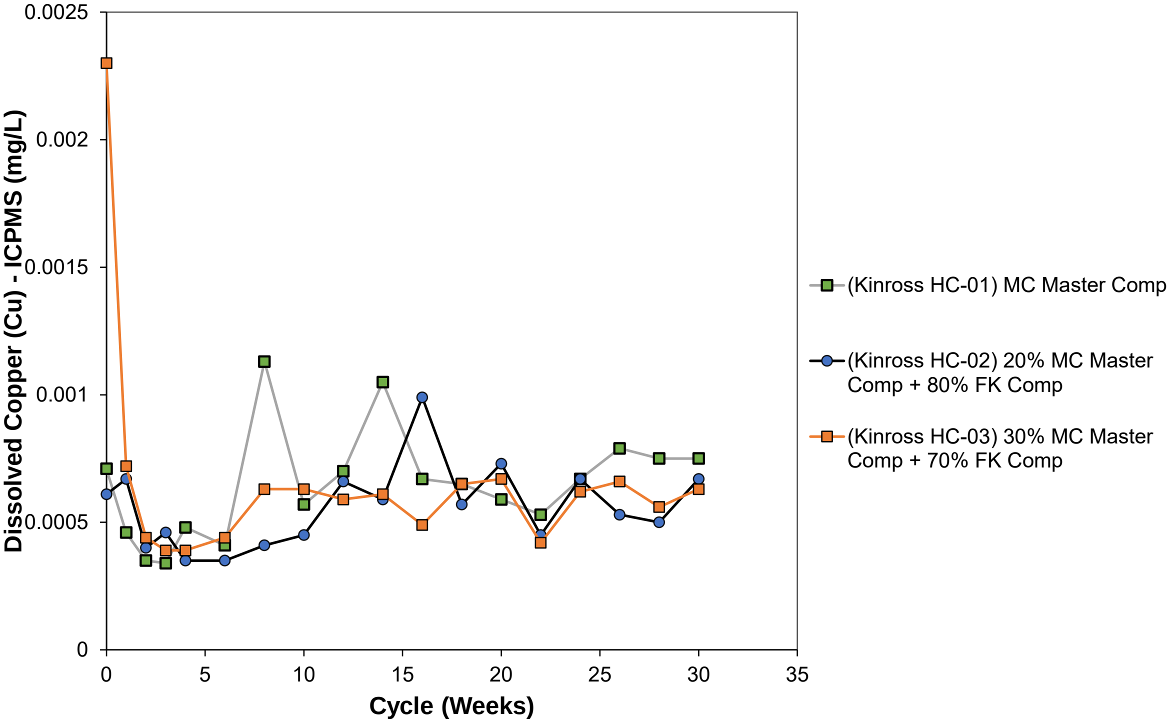
https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210_Additional HCTs/HCT/[Tetlin_Peak_Gold_HCT_Ore_conc charts_481900.030_rtc_rev01.xlsm

Figure 5-36: Timeseries Plot of HCT Total Alkalinity for Ore Samples



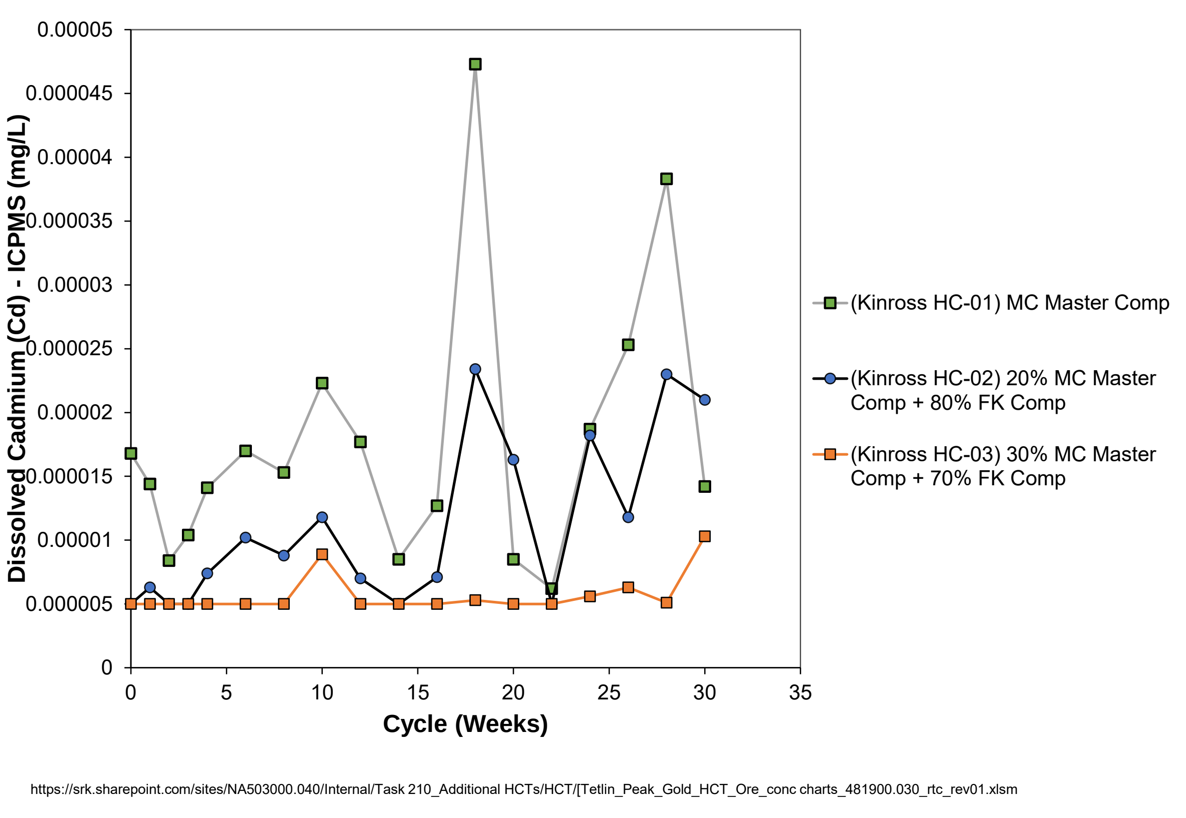
https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210_Additional HCTs/HCT/[Tetlin_Peak_Gold_HCT_Ore_conc charts_481900.030_rtc_rev01.xlsm

Figure 5-37: Timeseries Plot of HCT Arsenic for Ore Samples



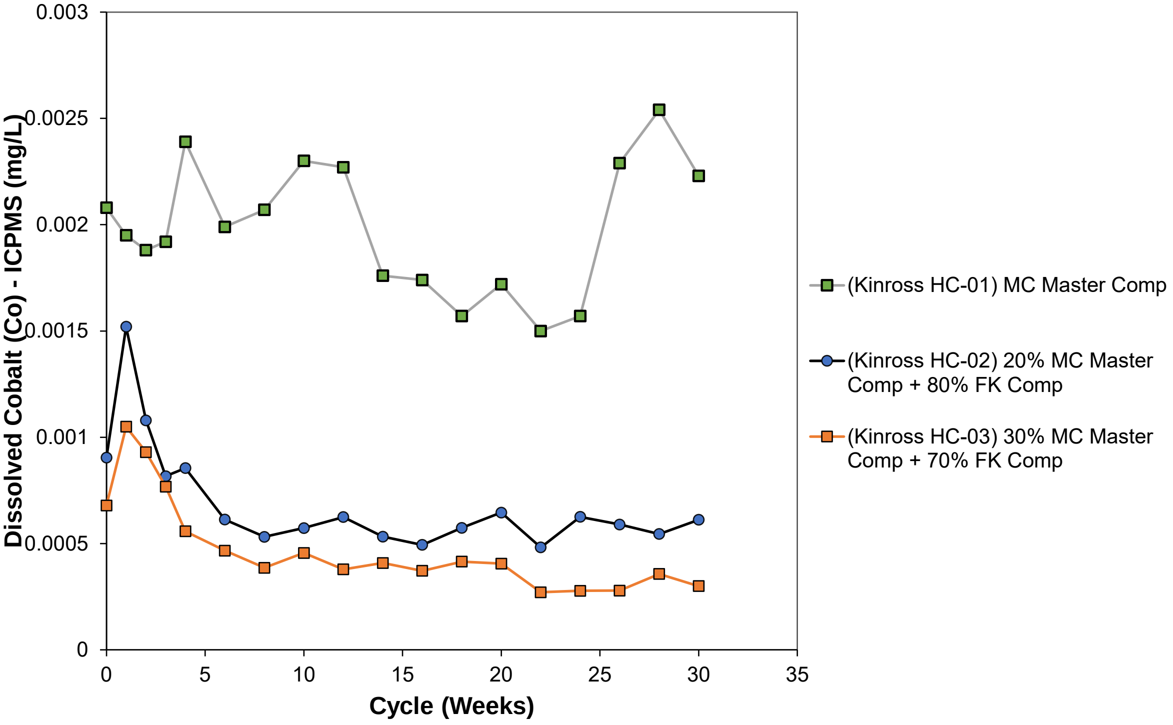
https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210_Additional HCTs/HCT/[Tetlin_Peak_Gold_HCT_Ore_conc charts_481900.030_rtc_rev01.xlsm

Figure 5-38: Timeseries Plot of HCT Copper for Ore Samples



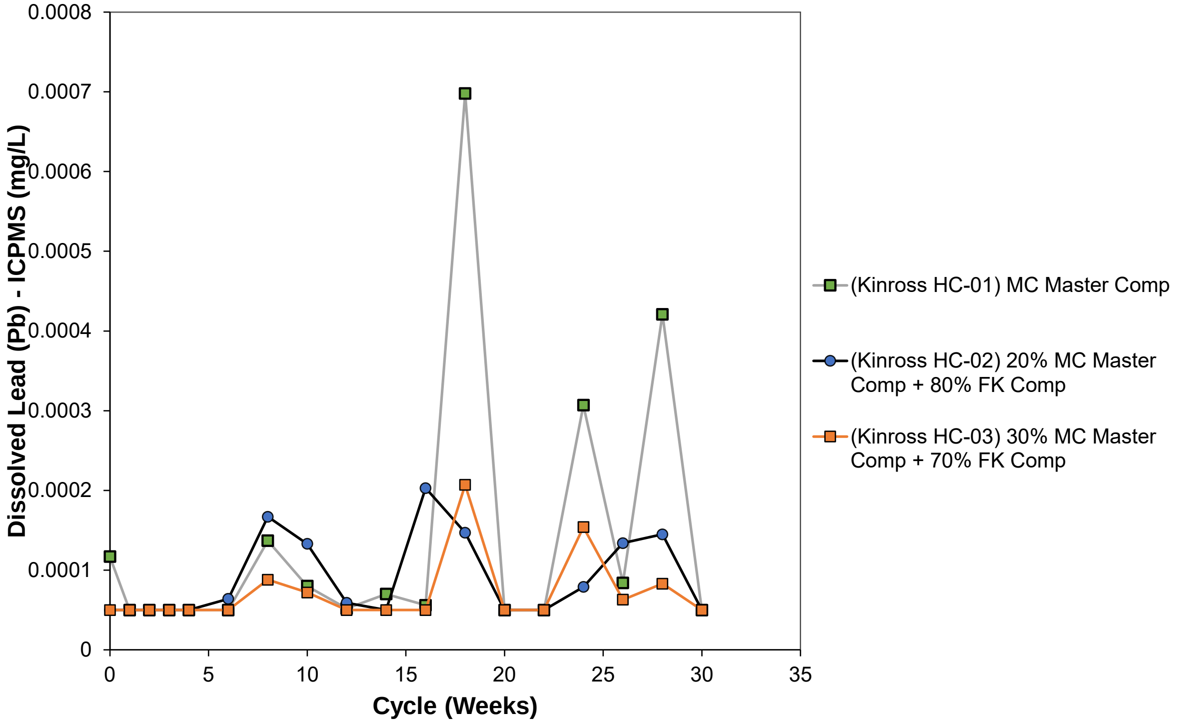
Week 18 and week 28 results appear anomalous and are currently under review.

Figure 5-39: Timeseries Plot of HCT Cadmium for Ore Samples



https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210_Additional HCTs/HCT/[Tetlin_Peak_Gold_HCT_Ore_conc charts_481900.030_rtc_rev01.xlsm

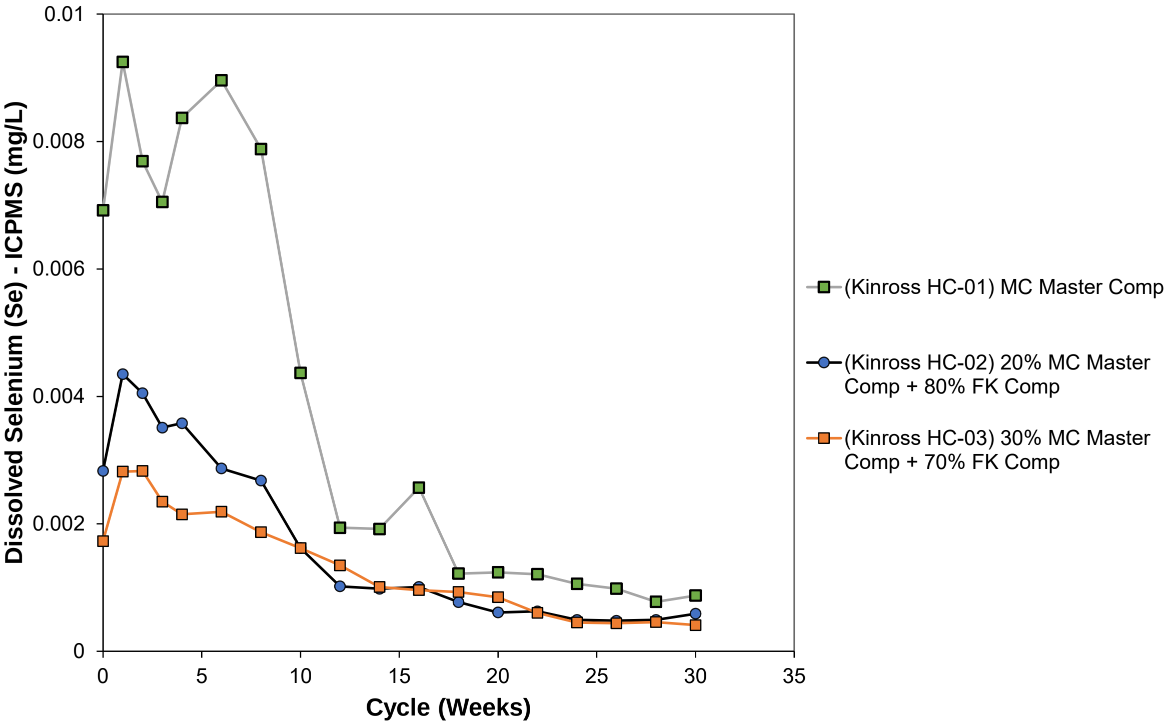
Figure 5-40: Timeseries Plot of HCT Cobalt for Ore Samples



https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210_Additional HCTs/HCT/[Tetlin_Peak_Gold_HCT_Ore_conc charts_481900.030_rtc_rev01.xlsm

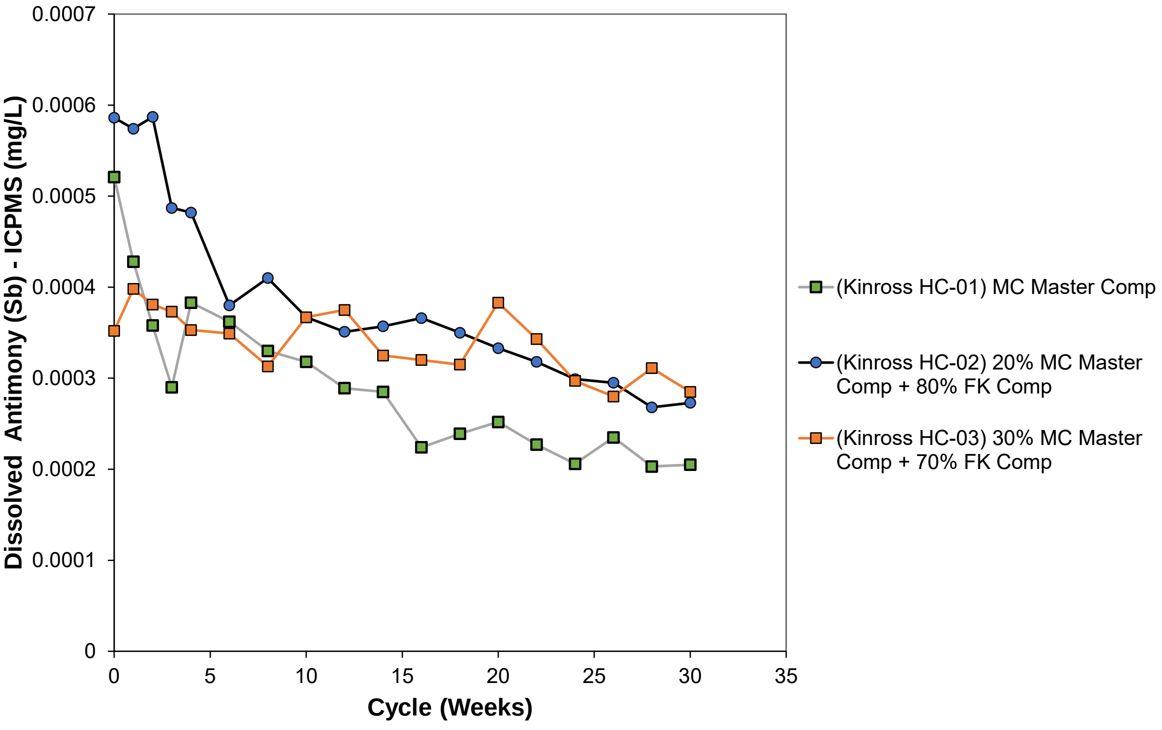
Week 18 and week 28 results appear anomalous and are currently under review.

Figure 5-41: Timeseries Plot of HCT Lead for Ore Samples



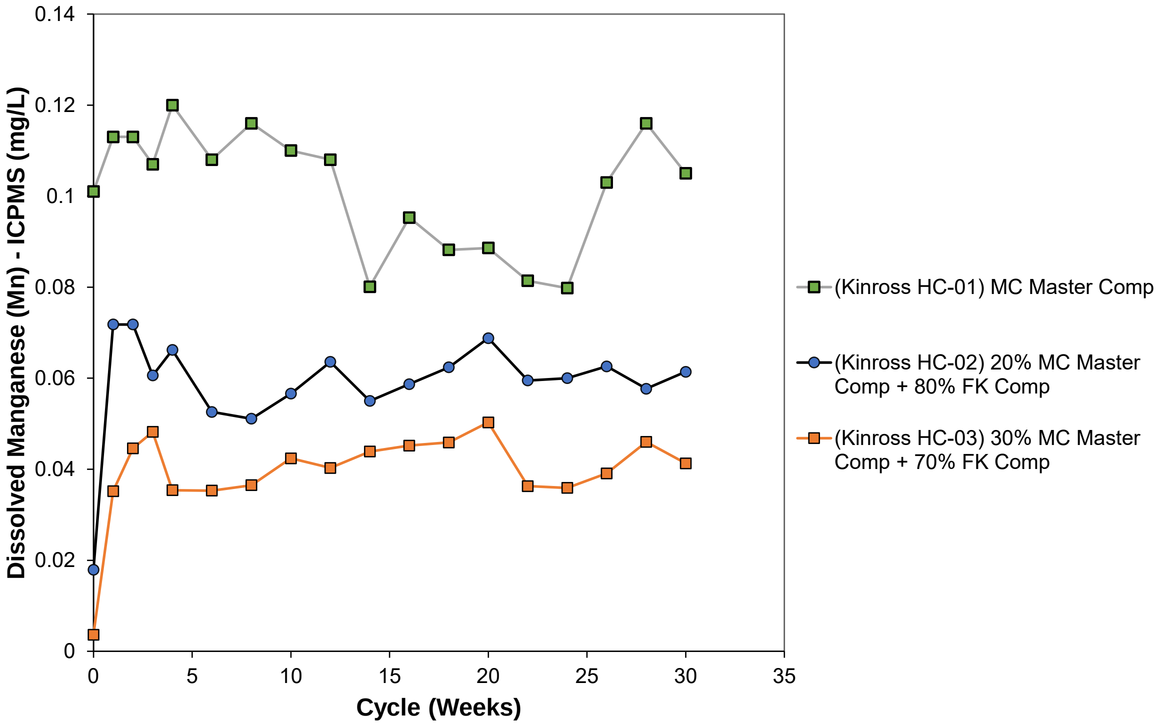
https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210_Additional HCTs/HCT/[Tetlin_Peak_Gold_HCT_Ore_conc charts_481900.030_rtc_rev01.xlsm

Figure 5-42: Timeseries Plot of HCT Selenium for Ore Samples



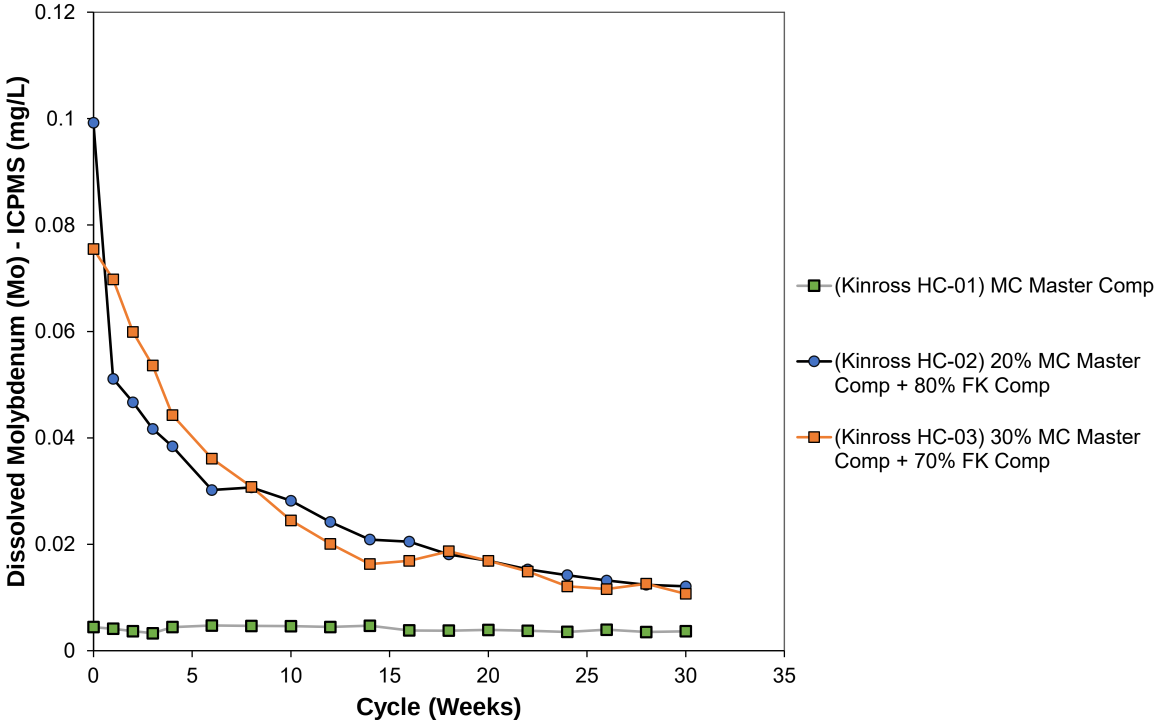
https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210_Additional HCTs/HCT/[Tetlin_Peak_Gold_HCT_Ore_conc charts_481900.030_rtc_rev01.xlsm

Figure 5-43: Timeseries Plot of HCT Antimony for Ore Samples



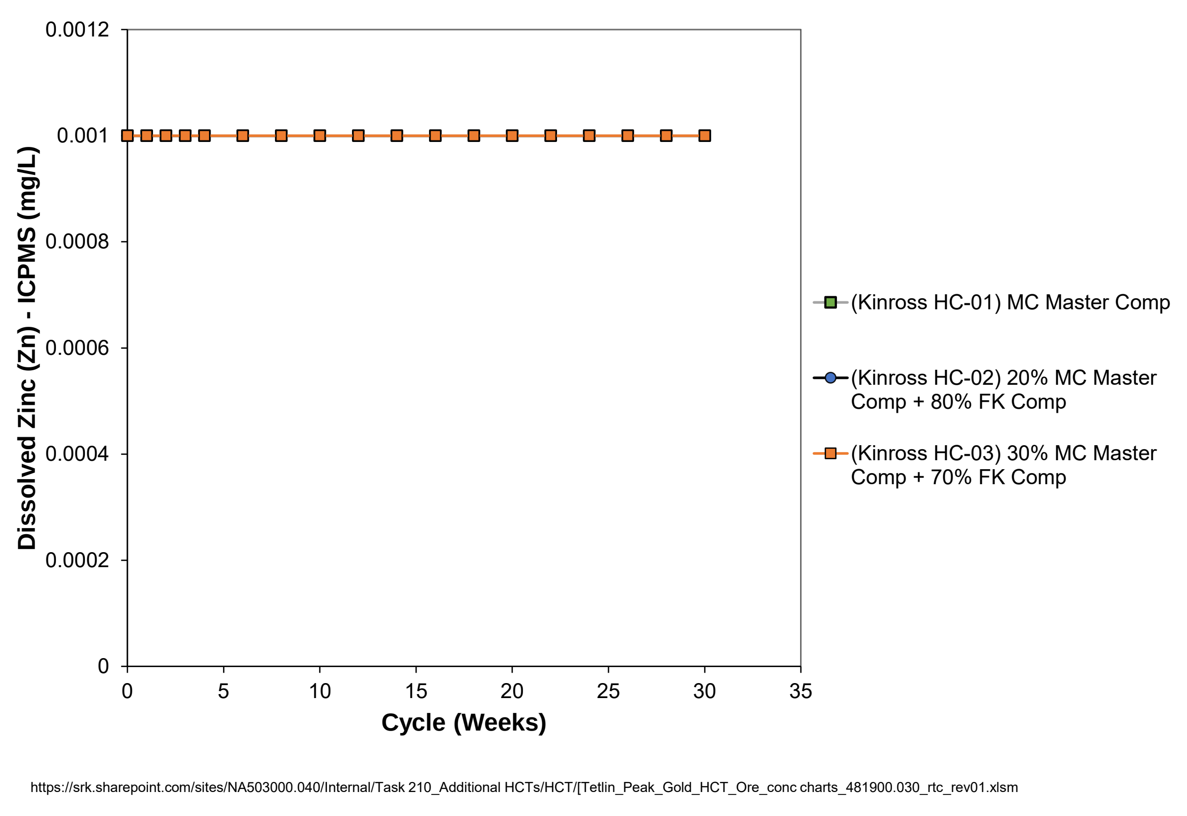
https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210_Additional HCTs/HCT/[Tetlin_Peak_Gold_HCT_Ore_conc charts_481900.030_rtc_rev01.xlsm

Figure 5-44: Timeseries Plot of HCT Manganese for Ore Samples



https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210_Additional HCTs/HCT/[Tetlin_Peak_Gold_HCT_Ore_conc charts_481900.030_rtc_rev01_20220915.xlsm

Figure 5-45: Timeseries Plot of HCT Molybdenum for Ore Samples



https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210_Additional HCTs/HCT/[Tetlin_Peak_Gold_HCT_Ore_conc charts_481900.030_rtc_rev01.xlsm

Figure 5-46: Timeseries Plot of HCT Zinc for Ore Samples

5.2.8 Ore and Tailings Summary

Ore

Geochemical characterization of the three ore samples indicate:

- All samples are predicted to be PAG and have been selected to undergo further humidity cell testing according to the permit requirements (NP/AP less than 3:1).
- Solid phase arsenic and silver was more than 10 times average global abundance for shale in all of the ore samples.
- The Master Composite also reported cobalt, copper, molybdenum, and selenium more than 10 times reference values and the 30% blend composition reported elevated copper.
- Leachable arsenic and manganese concentrations were elevated relative to Profile II reference values in all ore samples, as indicated by MWMP.
- Leachable TDS and sulfate concentrations were also elevated relative to Profile II reference values in the Master Composite and the blended sample 30% Manh Choh / 70% Fort Knox, as indicated by MWMP.

Mineralogical analysis of the ore samples showed:

- Pyrrhotite was the main sulfide mineral identified in the samples but pyrite, chalcopyrite and arsenopyrite were also present.

- The acidic sulfate mineral jarosite was reported in all three ore samples.
- The only carbonate mineral identified was calcite.
- Humidity cell testing on the three ore samples to Week 30 shows:
- pH is circum-neutral to moderately alkaline
- Arsenic mobilisation is occurring but shows no trends at present.

A number of parameters consistently report higher concentrations in the Manh Choh ore sample (Kinross HC-01) relative to the other ore blends (Kinross HC-02 and HC-03) including EC, sulfate, cobalt, selenium and manganese.

Tailings

Five detoxified tailings underwent geochemical characterization. The samples were produced by metallurgical process simulation testing on the three ore samples under variable test conditions. Key findings were as follows:

- Acid generating potential remains the same as the raw ore samples and all samples are predicted to be PAG.
- Solid phase arsenic remained more than 10 times average global abundance in all of the tailings samples.
- Cobalt, copper molybdenum, silver, and selenium were also elevated by more than 10 times crustal abundance in the two Manh Choh Master Composite detoxified tailings samples.
- The 30% blend tailings also reported elevated copper, molybdenum, and silver.
- Leachability was higher in the tailings samples compared to the raw ore samples. The MWMP leachates reported higher TDS, arsenic, sulfate, antimony, cobalt and total nitrogen.
- MWMP arsenic and antimony concentrations exceeded Profile II screening values in all tailings samples. Sulfate and total nitrogen concentrations in the MWMP leachates also exceeded Profile II in all samples except for the 20% blend sample.
- WAD cyanide was elevated relative to Profile II screening values in all samples.

The detoxified tailings solutions were also analyzed and compared to Profile II. Concentrations were typically higher in these solutions than reported in the MWMP leachates indicating a potential for elevated deleterious elements in the tailings porewaters:

- Concentrations of TDS, sulfate, arsenic, cobalt, iron, and total nitrogen were all elevated in the tailings solutions relative to the tailings MWMP leachates.
- Concentrations of TDS, sulfate, arsenic, antimony, cadmium, copper, iron, manganese, and WAD cyanide were elevated in one or more tailings solution sample relative to Profile II screening values.

5.3 Construction Materials

5.3.1 Acid Potential

ABA results are summarized in Table 3-1. Paste pH values range from 6.3 to 8.7; total sulfur and sulfide sulfur content is low in all samples ranging between <0.01 and 0.04%. AP* has been calculated using the site-specific equation discussed in Section 5.1.2.

5.3.2 Neutralization Potential

Figure 5-33 presents modified neutralization potential as reported by BV versus site specific NP (NP*) calculated directly from total inorganic carbon (Section 5.1.3). Modified NP is higher than NP* in the majority of samples reflecting the presence of silicate minerals but in several samples NP* exceeds modified NP indicating that iron carbonates could be present.

5.3.3 Acid Rock Drainage Potential

NP*/AP* ratios are presented graphically in Figure 5-5. The classification used for oxide waste rock has been applied as a basis for classifying the construction material samples, in this instance material is non-acid generating (NAG) if NP*/AP* is >2. All samples analyzed are classified as NAG except for three of the quartz-mica-schist samples. These samples contain minimal AP* and only fall into the potentially acid generating (PAG) criteria because they contain minimal NP*, so they are effectively inert. Total sulfur and sulfide sulfur is below detection limit in these three samples.

5.3.4 Element Leaching Potential

Table 3-1 presents a summary of multi-element concentrations for key parameters. The results were compared to ten times global average crustal abundance for shale (Price 1997) to screen for any elemental enrichment within the construction materials. Most results show no enrichment relative to the screening criteria; elevated concentrations were only reported for the following parameters:

- Sample TP02, S-1 (quartz-mica-schist) reports exceedances for silver (1.1 ppm relative to a screening criteria of 0.7 ppm), cadmium (4.0 ppm relative to a screening criteria of 3.0 ppm) and most notably chromium (2,600 ppm relative to a screening criteria of 900 ppm). This sample appears to be anomalous relative to the rest of the dataset and also reports higher concentrations of other parameters including gold (13 ppb).
- Sample TP02, S-2 reports a minor exceedance for silver (0.9 ppm relative to a screening criteria of 0.7 ppm) and a slight enrichment in gold (3.2 ppb).

Trial pit TP02 is located along the road alignment and situated closest to the future mine site relative to the other road samples. The enrichment seen in sample TP02, S-1 was not apparent in any other nearby samples with the exception of a minor enrichment in S-2, collected slightly deeper within the same pit and TP03, S1 (gold 1.9 ppb). The deepest sample collected TP02 (S3), reported gold at less than detection limit.

Table 3-9: Summary of ABA Results and Multi-Element Analysis of Key Parameters

Sample ID	Top Depth	USCS Soil / Rock Type	Paste pH	TIC	Total Sulfur	Sulfate Sulfur	Sulfide Sulfur	AP*	Mod. ABA Neutralization Potential	NP* Calculated from TIC	NP*/AP*	Ag	As	Au	Cd	Co	Cr	Cu	Mn	Pb	Sb	Se	Zn
	Feet		pH Units	wt%				Kg $CaCO_3$/T				ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
10 x Average Crustal Abundance>>												***0.70***	***130.0***	***--***	***3.00***	***190***	***900***	***450***	***8500***	***200***	***15.0***	***6.0***	***950***
TP01, S-1	1	Mica-Quartz-Schist	7.2	0.04	<0.01	<0.01	<0.02	<0.6	4.5	0.9	**1.5**	0.05	3.4	<0.5	0.06	9.7	310	22	150	11	0.15	<0.1	39
TP02, S-1	2.5	Quartz-Mica-Schist	7.7	0.60	0.03	<0.01	0.03	0.9	9.0	14	15	1.1	34	13	4.0	27	2600	69	2900	150	2.6	0.4	430
TP02, S-2	2.5	Elastic Silt	7.5	0.10	<0.01	<0.01	<0.02	<0.6	2.0	2.3	3.6	0.87	40	3.2	1.8	9.5	130	14	950	84	5.0	0.2	200
TP02, S-3	7.8	Igneous	7.4	3.30	<0.01	<0.01	<0.02	<0.6	58	75	120	0.24	18	<0.5	0.88	9.5	130	8.7	790	26	3.1	0.2	110
TP03, S-1	2.5	Andesite	7.7	0.55	<0.01	0.01	<0.02	<0.6	10	13	20	0.36	25	1.9	0.24	13	140	64	620	36	2.8	0.2	88
TP05, S-1	0.5	Silty Gravel	7.5	0.48	<0.01	<0.01	<0.02	<0.6	0.7	11	17	0.05	5.5	<0.5	0.05	15	160	38	550	13	0.29	0.2	61
TP05, S-2	2.5	Quartz-Mica-Schist	7.3	0.03	<0.01	<0.01	<0.02	<0.6	2.3	0.7	**1.1**	0.07	3.6	<0.5	0.10	16	120	60	410	28	0.18	<0.1	95
TP06, S-2	2.5	Quartz-Mica-Schist	7.4	<0.01	<0.01	<0.01	<0.02	<0.6	4.5	0.0	**0.0**	0.02	0.4	<0.5	0.03	9.7	210	10	420	2.7	0.03	0.1	39
TP07, S-2	3.5	Quartz-Mica-Schist	7.5	0.09	<0.01	<0.01	<0.02	<0.6	3.2	2.0	3.3	0.03	0.7	<0.5	0.03	11	240	15	320	3.6	0.09	0.2	48
TP10, S-1	1.5	Quartz-Mica-Schist	6.4	0.07	<0.01	<0.01	<0.02	<0.6	7.5	1.6	2.5	0.07	2.1	<0.5	0.05	13	220	37	490	16	0.08	<0.1	98
TP12, S-1	2.5	Quartz-Mica-Schist	7.1	0.14	<0.01	<0.01	<0.02	<0.6	7.7	3.2	5.1	0.02	6.1	<0.5	0.01	15	200	24	450	6.8	0.14	0.1	54
TP15, S-2	3	Mica-Quartz-Schist	6.3	0.25	<0.01	<0.01	<0.02	<0.6	1.5	5.7	9.1	0.02	12	<0.5	0.02	8.0	260	20	280	9.6	1.4	0.1	37
TP19, S-1	1	Low plasticity silt	6.5	1.20	<0.01	0.05	<0.02	<0.6	5.7	28	44	0.12	22	<0.5	0.13	16	93	48	710	23	0.93	0.4	81
TP19, S-2	2.5	Silty Gravel	7.9	0.22	0.02	<0.01	0.02	0.6	7.0	5.0	8.0	0.07	13	<0.5	0.08	16	130	32	830	6.2	0.69	0.4	52
TP21, S-1	2	Poorly Graded Sand with Gravel	7.8	0.12	0.01	<0.01	<0.02	<0.6	5.5	2.7	4.4	0.05	7.6	<0.5	0.11	12	160	41	520	6.3	1.1	0.2	51
TP21, S-2	3	Poorly Graded Gravel with Sand	8.6	0.36	0.04	<0.01	0.04	1.3	13	8.2	6.5	0.06	6.2	<0.5	0.11	12	130	43	630	5.3	0.56	<0.1	48
TP22, S-1	0.5	Silty Gravel	7.6	0.19	0.02	0.01	<0.02	<0.6	6.5	4.3	6.9	0.04	5.7	<0.5	0.07	16	120	53	630	6.2	0.36	0.3	60
TP22, S-2	3	Poorly Graded Gravel with Sand	8.6	0.26	0.03	0.01	0.02	0.6	12	5.9	9.5	0.06	3.9	<0.5	0.08	17	130	60	610	4.6	0.35	0.2	53
TP23, S-1	2.7	Low plasticity silt	7.7	0.27	<0.01	<0.01	<0.02	<0.6	7.3	6.1	9.8	0.07	7.0	<0.5	0.08	13	78	47	340	8.3	0.47	0.2	51
TP23, S-2	4	Poorly Graded Sand with Silt and Gravel	8.7	0.92	0.01	<0.01	<0.02	<0.6	26	21	33	0.06	11	<0.5	0.15	13	120	53	560	6.0	0.40	0.2	56
TP23, S-4	14	Poorly Graded Gravel with Sand	8.7	1.50	0.03	<0.01	0.03	0.9	29	33	36	0.07	5.4	<0.5	0.14	14	110	62	590	5.9	0.40	0.3	59
GP01, S-1	Stockpile	Poorly Graded Gravel with Sand	8.5	0.41	0.04	0.02	0.02	0.6	15	9.3	15	0.07	3.8	<0.5	0.10	17	120	55	580	4.4	0.26	0.2	49
GP03, S-1	Stockpile	Poorly Graded Gravel with Sand	8.7	0.17	0.02	<0.01	0.02	0.6	5.8	3.9	6.2	0.06	5.8	<0.5	0.15	8.0	200	43	430	9.6	0.45	0.3	45
BTP02, S-1	1.5	Silty Gravel	7.9	0.09	<0.01	<0.01	<0.02	<0.6	1.3	2.0	3.3	0.01	1.2	<0.5	<0.01	4.0	170	16	320	6.8	0.62	<0.1	19

Source: https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 600 Construction Material/Testwork Results/[Manh Choh Construction Materials_503000040_v2_MC_SJD.xl

Notes:
Results rounded to 2 significant figures
Logging details provided by Shannon & Wilson
AP*: Site specific acid potential
NP*: Site specific neutralization potential
TIC: Total Inorganic Carbon (reported as CO_2%)
Bold NP*/AP* indicates <2, PAF classification
Gray shading indicated that the result exceeds 10 average crustal abundance for sedimentary shale rocks from Price (1997).

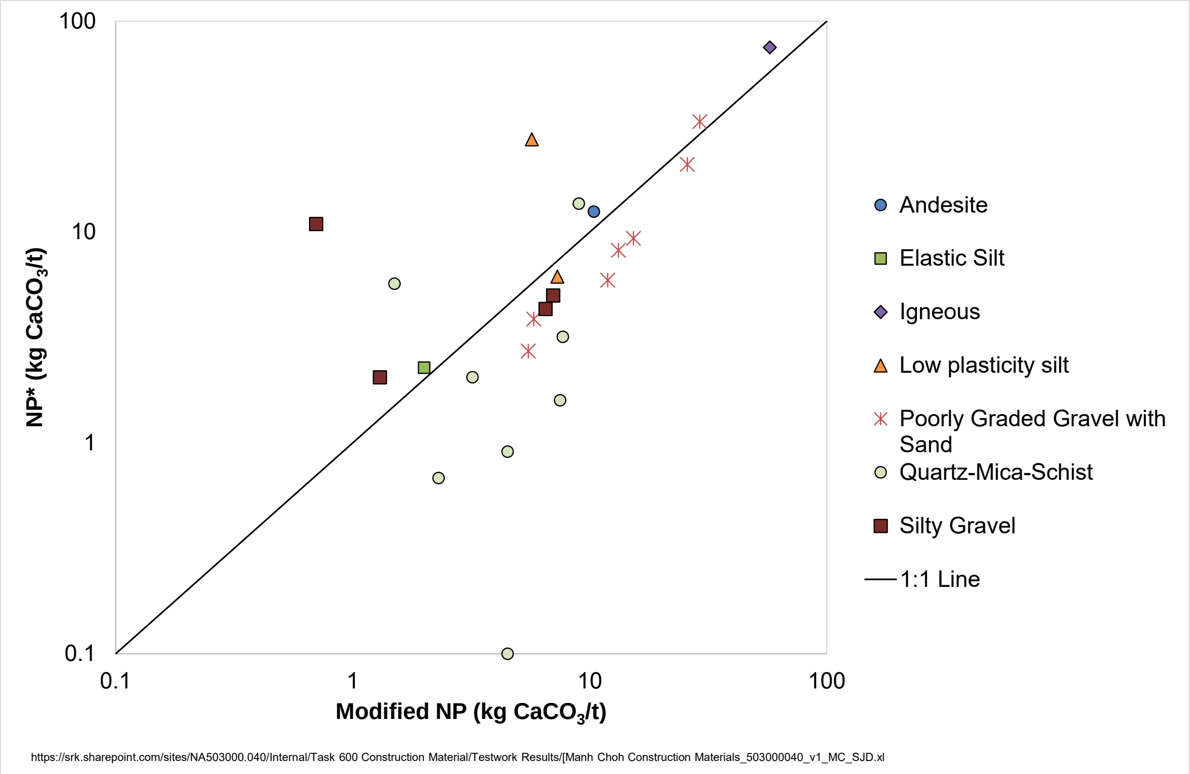


Figure 5-47: Modified NP versus NP* (Calculated from TIC)[3]

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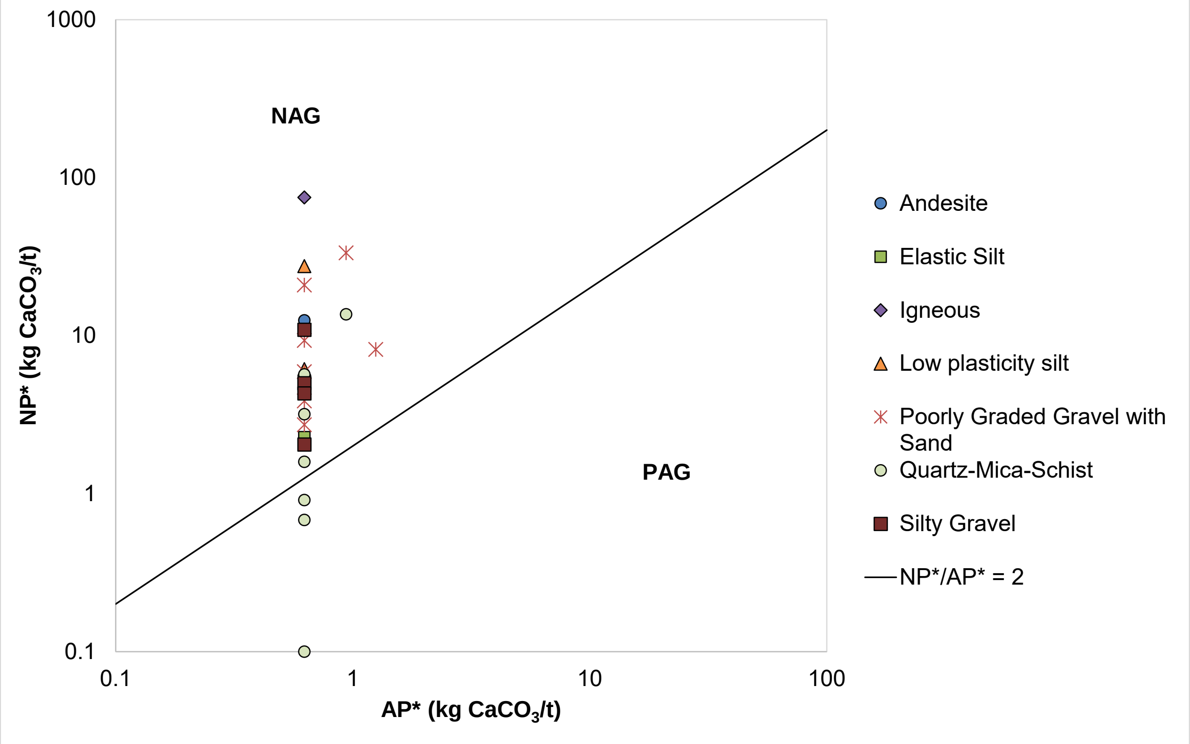
[3] NP* for sample TP06, S-2 reported at 0 $kgCaCO_3/t$ but set to 0.1 $kgCaCO_3/t$ for graphing purposes only.



https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 600 Construction Material/Testwork Results/[Manh Choh Construction Materials_503000040_v1_MC_SJD.xl

Figure 5-48: AP* versus NP*[2]

When compared to average crustal abundance, multi-element data provide an indication of elemental enrichment that may be of environmental importance and can identify parameters that might be of concern for the project. The soluble or leachable portion of these elements, however, needs to be estimated empirically by leach tests such as the MWMP, which account for site specific factors that affect mineral solubility

Table 3-2 presents MWMP results for key parameters. The results are compared to the most stringent Alaskan water quality guidelines. The guidelines are a mixture of freshwater aquatic, irrigation and drinking water standards. These guidelines are not directly applicable to interpretation of leachate chemistry but have been used as a preliminary screening for guidance purposes only.

Key findings are summarized as follows:

- Leachate pH ranges between 5.0 and 8.3. Nine samples report pH less than the screening criteria of pH 6.5, these are predominantly, but not exclusively, quartz-mica-schist samples.
- Six samples report total alkalinity <20 mg/L as CaCO3.
- Most samples report elevated leachate concentrations of aluminum and copper relative to the screening criteria. Aluminum concentrations range from 0.02 to 1.4 mg/L relative to the Freshwater Aquatic Life, Chronic threshold of 0.087 mg/L. Copper concentrations range from 0.001 to 0.12 mg/L relative to Freshwater Aquatic Life, Chronic thresholds between 0.001 and 0.03 mg/L depending upon hardness.
- Concentrations of manganese and lead are above the screening criteria in two or more samples.

- There are single instances where fluoride, arsenic, nickel, antimony and selenium concentrations are elevated.
- Concentrations of mercury are above the screening criteria in eight samples. All other samples report mercury concentrations at detection limit (<0.00005 to <0.0001 mg/L). However, the detection limit is higher than the screening criteria and a comparison cannot be made for the values reported below the detection limit.
- Although sample TP02, S-1 reported enrichment of a number of parameters, these were not readily leachable in MWMP test and no elevated parameters were reported for this sample.

The above exceedances of the screening criteria are likely a reflection of the conservative nature of the MWMP test procedure rather than an indication of a potential to leach deleterious metals from these samples under field conditions. The test procedure involves leaching with deionized water (around pH 5.5) and since there is low carbonate buffering capacity within the samples, the reagent is not neutralized within the specified test period which results in lower MWMP pH that could increase the potential for metal release.

5.3.5 Construction Materials Summary

The twenty-four samples representative of construction materials showed that the acid rock drainage potential from these samples is negligible. The majority of the MWMP results indicate negligible potential for metal leaching with the exception of aluminum, copper and to a lesser extent manganese, that are leached at concentrations above the most stringent guidelines under mildly acidic to neutral pH conditions. The leaching of these parameters is likely a reflection of the conservative nature of the MWMP test procedure, and more representative of a potential initial flush rather than an indication of long-term release under field conditions.

Overall, these materials can be considered suitable for construction due to the low potential for leaching under site conditions.

Table 3-10: Summary of MWMP Results

Sample ID	Top Depth	USCS Soil / Rock Type	pH	EC	SO_4	Total Alkalinity as $CaCO_3$	F	Al	As	Cd	Co	Cr	Cu	Fe	Hg	Mn	Mo	Ni	Pb	Sb	Se	Zn
				uS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
		Most stringent Alaska WQS>	6.5-8.5	--	--	20	1.0	0.087	0.010	0.0002-0.007*	0.05	0.10	0.001-0.03*	1.00	0.000012	0.05	--	0.007-0.16*	0.0002-0.01*	0.006	0.005	0.01-0.4*
	Feet		Fresh Water Aquatic Life			Fresh Water Aquatic Life, Chronic	Irrigation Water	Fresh Water Aquatic Life, Chronic	Drinking Water	Fresh Water Aquatic Life, Chronic	Irrigation Water	Drinking and Irrigation Water	Fresh Water Aquatic Life, Chronic	Fresh Water Aquatic Life, Chronic	Fresh Water Aquatic Life, Chronic	Human Health (Consumption of Water + Aquatic Organisms)		Fresh Water Aquatic Life, Chronic	Fresh Water Aquatic Life, Chronic	Drinking Water	Fresh Water Aquatic Life, Chronic	Fresh Water Aquatic Life, Acute
TP01, S-1	1	Mica-Quartz-Schist	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TP02, S-1	2.5	Quartz-Mica-Schist	8.3	300	6.1	120	0.12	0.02	0.0007	0.00006	0.00006	0.007	0.006	0.032	<0.00005	0.0032	0.00061	0.00060	0.00019	0.0014	0.0005	0.0017
TP02, S-2	2.5	Elastic Silt	7.3	35	7.0	9.3	0.13	0.53	0.0016	0.00004	0.0001	0.003	0.002	0.35	<0.00005	0.0046	0.00086	0.0014	0.00054	0.0012	0.0003	0.0036
TP02, S-3	7.8	Igneous	8.1	140	2.1	62	0.27	0.02	0.0006	0.00001	0.00003	0.007	0.001	0.014	<0.00005	0.0028	0.0028	0.0003	0.00003	0.0006	0.0001	0.0007
TP03, S-1	2.5	Andesite	7.5	230	3.0	90	0.10	0.06	0.0035	0.00006	0.0004	0.004	0.12	0.092	<0.00005	0.027	0.0010	0.0028	0.00065	0.0028	0.0011	0.0037
TP05, S-1	0.5	Silty Gravel	5.3	320	6.0	110	0.07	1.40	0.0016	0.0002	0.004	0.007	0.060	0.29	<0.00005	0.51	<0.00005	0.0028	0.00023	0.0005	0.0013	0.013
TP05, S-2	2.5	Quartz-Mica-Schist	6.1	180	6.0	63	0.05	0.19	0.0010	0.00006	0.001	0.002	0.073	0.21	0.00012	0.10	0.00007	0.0055	0.00022	0.0004	0.0007	0.0078
TP06, S-2	2.5	Quartz-Mica-Schist	5.0	37	<0.5	9.1	0.03	0.17	0.0005	0.00002	0.0005	0.001	0.047	0.11	<0.00005	0.024	<0.00005	0.0005	0.00014	0.0001	0.0003	0.0032
TP07, S-2	3.5	Quartz-Mica-Schist	6.0	53	1.8	17.0	0.07	0.05	0.0003	0.00002	0.0003	0.0002	0.012	0.071	<0.00005	0.0091	0.00007	0.0011	0.00010	0.0001	0.0004	0.0029
TP10, S-1	1.5	Quartz-Mica-Schist	6.3	50	7.0	13.0	0.05	0.19	0.0003	0.00002	0.0003	0.001	0.014	0.15	<0.0001	0.032	<0.0001	0.0024	0.00017	0.0001	0.0003	0.0031
TP12, S-1	2.5	Quartz-Mica-Schist	6.4	170	<5.0	60	0.21	0.17	0.0016	0.00002	0.0005	0.007	0.067	0.16	0.00019	0.041	0.00012	0.011	0.00027	0.0006	0.0022	0.0022
TP15, S-2	3	Mica-Quartz-Schist	5.7	36	<0.5	4.0	0.09	1.10	0.0009	0.00005	0.003	0.003	0.015	0.52	<0.00005	0.033	<0.00005	0.013	0.0020	0.0002	0.0004	0.0031
TP19, S-1	1	Low plasticity silt	6.9	660	<5.0	290	0.20	0.16	0.0029	0.00020	0.007	0.011	0.097	0.17	0.000091	1.7	0.00033	0.030	0.00014	0.0032	0.0058	0.0047
TP19, S-2	2.5	Silty Gravel	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TP21, S-1	2	Poorly Graded Sand with Gravel	6.3	140	<5.0	47	0.17	0.51	0.0022	0.00007	0.001	0.003	0.11	0.49	0.000061	0.14	0.00046	0.0063	0.00023	0.0008	0.0017	0.0030
TP21, S-2	3	Poorly Graded Gravel with Sand	7.5	90	<5.0	39	0.38	0.10	0.0015	0.00002	0.000	0.001	0.051	0.16	<0.00005	0.065	0.0015	0.0034	0.00013	0.0005	0.0007	0.0023
TP22, S-1	0.5	Silty Gravel	6.4	58	<5.0	14	0.12	0.27	0.0013	0.00003	0.001	0.002	0.038	0.084	<0.00005	0.28	0.00009	0.0010	0.00010	0.0002	0.0008	0.0014
TP22, S-2	3	Poorly Graded Gravel with Sand	7.4	54	6.0	21	0.36	0.05	0.0010	0.00002	0.0003	0.0003	0.046	0.05	<0.00005	0.056	0.00073	0.0021	0.00004	0.0003	0.0005	0.0013
TP23, S-1	2.7	Low plasticity silt	7.3	190	<5.0	75	0.82	0.09	0.014	0.00003	0.0003	0.004	0.12	0.14	0.00014	0.016	0.0026	0.018	0.00014	0.010	0.0028	0.0019
TP23, S-2	4	Poorly Graded Sand with Silt and Gravel	7.9	200	<5.0	93	0.93	0.09	0.0081	0.00001	0.0001	0.001	0.029	0.087	0.000077	0.004	0.0015	0.0017	0.00005	0.0023	0.0010	0.0008
TP23, S-4	14	Poorly Graded Gravel with Sand	7.8	74	1.2	34	0.34	0.11	0.0044	0.00001	0.0001	0.0003	0.022	0.12	0.000085	0.008	0.0031	0.0006	0.00014	0.0009	0.0006	0.0013
GP01, S-1	Stockpile	Poorly Graded Gravel with Sand	7.8	120	6.0	49	0.23	0.03	0.0018	0.00001	0.0003	0.001	0.038	0.013	<0.00005	0.025	0.00097	0.0012	0.00003	0.0004	0.0009	0.0016
GP03, S-1	Stockpile	Poorly Graded Gravel with Sand	7.6	65	<5.0	29	0.51	0.06	0.0011	0.00002	0.0001	0.0002	0.025	0.090	<0.00005	0.018	0.0017	0.0011	0.00013	0.0003	0.0005	0.0014
BTP02, S-1	1.5	Silty Gravel	7.4	250	<50	43	1.10	0.06	0.0018	0.00002	0.0002	0.002	0.061	0.11	0.00012	0.011	0.0070	0.0036	0.00008	0.0012	0.0022	0.0020

Source: https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 600 Construction Material/Testwork Results/[Manh Choh Construction Materials_503000040_v2_MC_SJD.xl

Notes:
Results rounded to 2 significant figures
Logging details provided by Shannon & Wilson
There was insufficient sample to conduct an MWMP on sample TP01, S-1 and the MWMP was not completed for sample TP19, S-2 due to poor drainage.
* Indicates hardness dependent parameter, screening value calculated from sample hardness

<XXX	indicates detection limit exceeds WQS
XXX	indicates result exceeds WQS

6 Waste Classification Criteria

The geochemical characterization testwork available to date was used to develop recommendations for block model parameters used to predict the domains for waste rock management (SRK, 2021b). The recommendations represent an interim approach to enable the update for Feasibility Study level mine planning. These approaches are considered theoretically sound but will need to be confirmed using on-going data collection.

6.1 Domaining of ARD Potential

6.1.1 Approach

The geochemical characterization study has indicated the potential for acid rock drainage from a subset of materials in the deposits. The historic humidity cell testing has not produced acidic drainage despite elevated sulfide content (>1%) after 80 weeks of testing; however, the 2021 humidity cell testing on oxide material with sulfide content in the range of 0.01% to 0.09% has shown acidic leachate during the first four weeks of testing.

The following sections describe the recommended approach to using modelled parameters to predict the acid rock drainage potential of the deposits.

6.1.2 Acid Potential

Sulfur measured using ICP-MS was evaluated for use as a proxy for sulfide sulfur. Results indicated a statistically significant correlation between ICP S measured in the exploration database and sulfide content measured as part of SRK's geochemical baseline study (Figure 6-1). To reflect the strong positive skew in the data, and the different detection limits for sulfide S and ICP S, this regression equation was calculated from log values and without undetected sulfide values in the exploration database:

$$\text{Log}_{10}\ \text{Sulfide S (\%)} = 1.2 \times \text{Log}_{10}\ \text{ICP S (\%)} - 0.011$$

Site specific acid potential (AP*) can then be calculated from sulfide sulfur using the following equation:

$$AP^{*}(\text{kgCaCO}_3/\text{t}) = 31.25 \times \text{Sulfide S (\%)}$$

6.1.3 Neutralization Potential (NP)

A similar approach to sulfide was investigated for estimating neutralization potential whereby ICP calcium measured using four acid digestion was compared to laboratory measured neutralization potential. Results indicated the two were not sufficiently correlated for the purpose of block modeling (Figure 6-2).

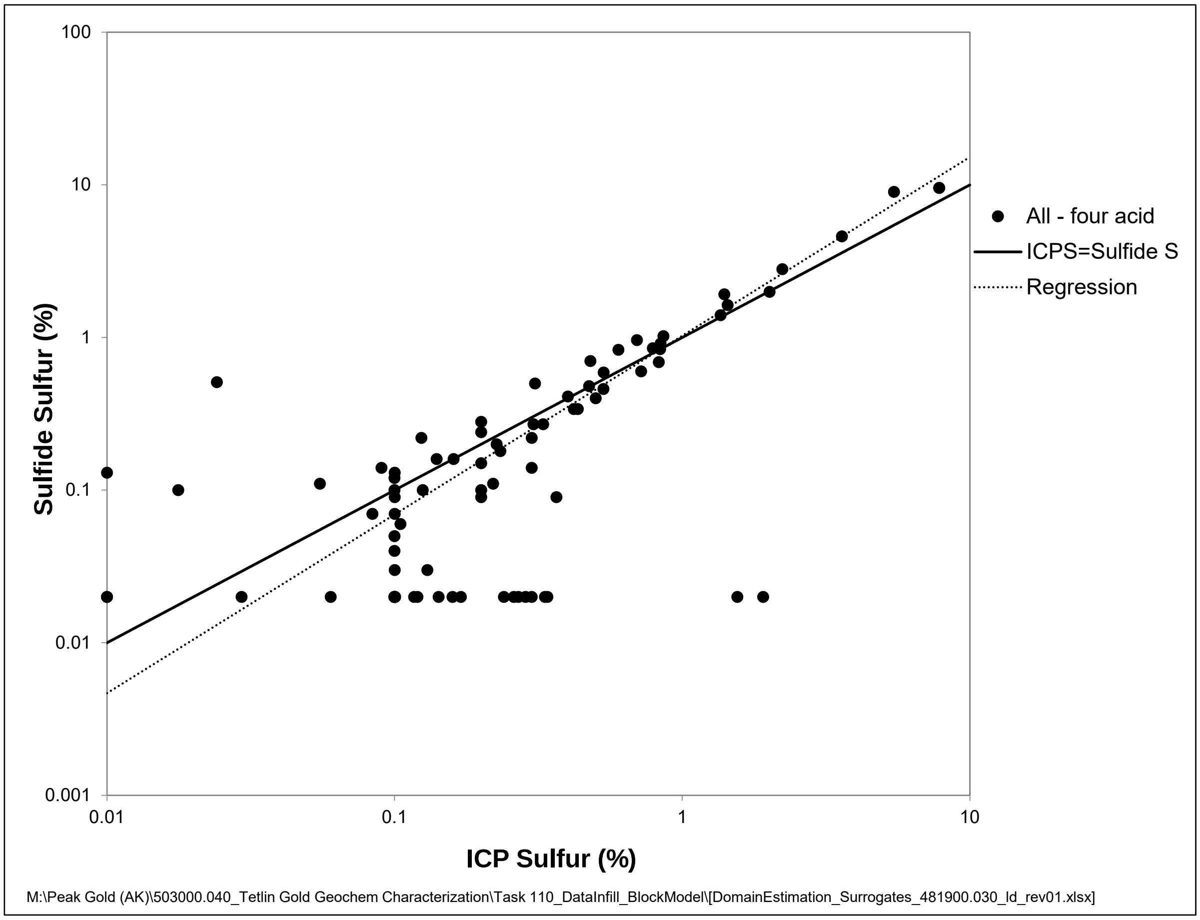
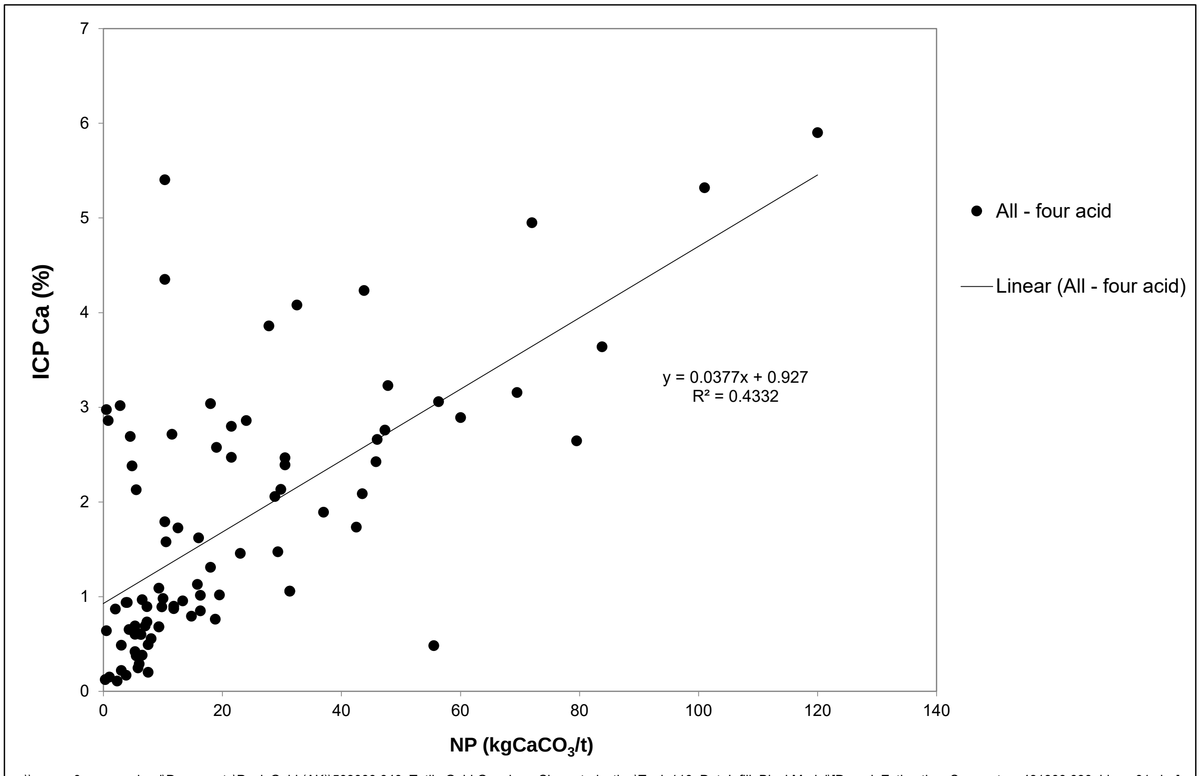


Figure 6-1: Comparison of Sulfide and Sulfur Determined by ICP-MS Following Four Acid Digestion



\\rno-svr0.rno.na.srk.ad\Documents\Peak Gold (AK)\503000.040_Tetlin Gold Geochem Characterization\Task 110_DataInfill_BlockModel\[DomainEstimation_Surrogates_481900.030_ld_rev01.xlsx]

Figure 6-2: Comparison of Neutralization Potential and Calcium Determined by ICP-MS Following Four Acid Digestion

Geochemical data collected as part of the SRK's baseline program indicates NP is correlated with TIC with NP being higher than TIC in all but three samples (Figure 6-3). This indicates TIC can be used as a proxy for NP and using TIC directly results in a conservative estimate for neutralization potential as it does not include potential buffering from silicate minerals.

This was the reason SRK recommended adding direct carbonate analysis (using $HClO_4$ digestion followed by CO_2 analysis by coulometer) to the exploration data suite for all samples tested during the 2020 and 2021 geotechnical and infill drilling programs (Section 2.4). Based on the mineralogical finding that reactive neutralization potential is dominated calcite, SRK recommended that the site-specific neutralization potential (NP*) could be calculated using:

$$NP^*(kgCaCO_3/t)=CO_2(\%)\times(\frac{100.08}{44.01})\times10$$

CO_2(%) is the analytically reported measure of TIC. If TIC is not detected, the concentration should be assigned a value of 0% and NP* is 0 kg $CaCO_3$/t.

Since carbonate is only available for recently sampled rock but calcium concentrations have been determined routinely as part of ICP multi-element scans following four acid digest, Kinross calculated a polynomial relationship between calcium and NP, as shown in Figure 6-4, to populate the block model with NP*:

$$NP^* = -1.61 + 5.57 \times Ca + 1.12 \times Ca^2$$

Calcium concentrations are in percent.

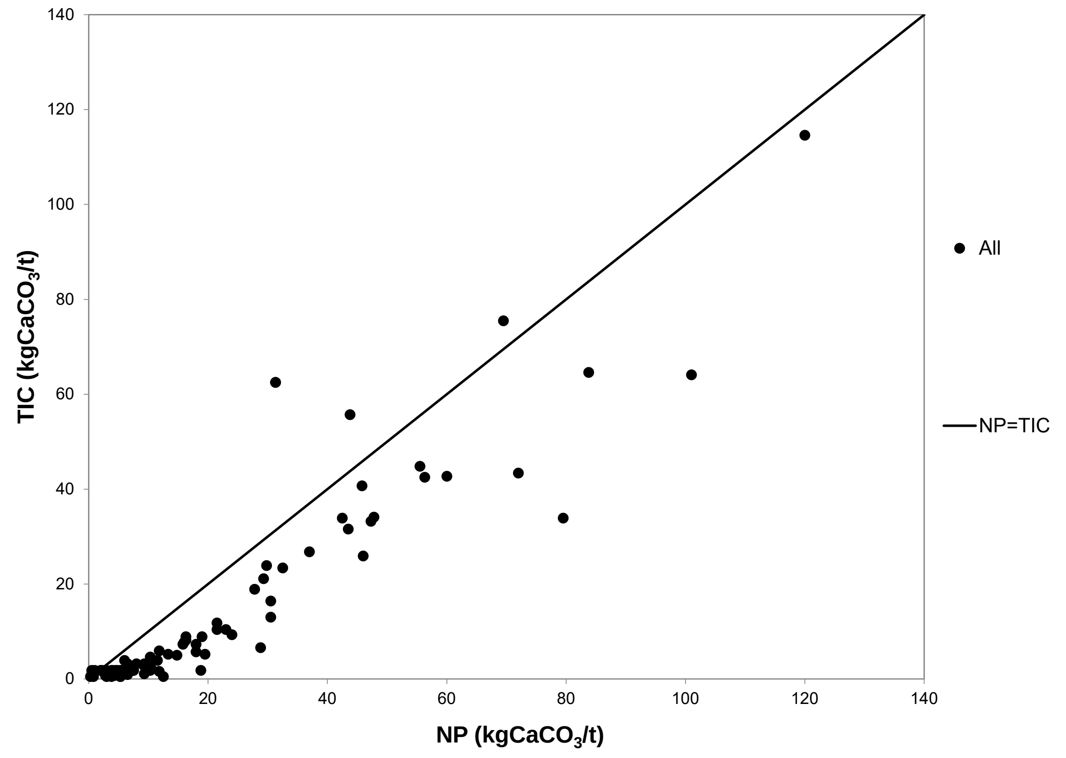


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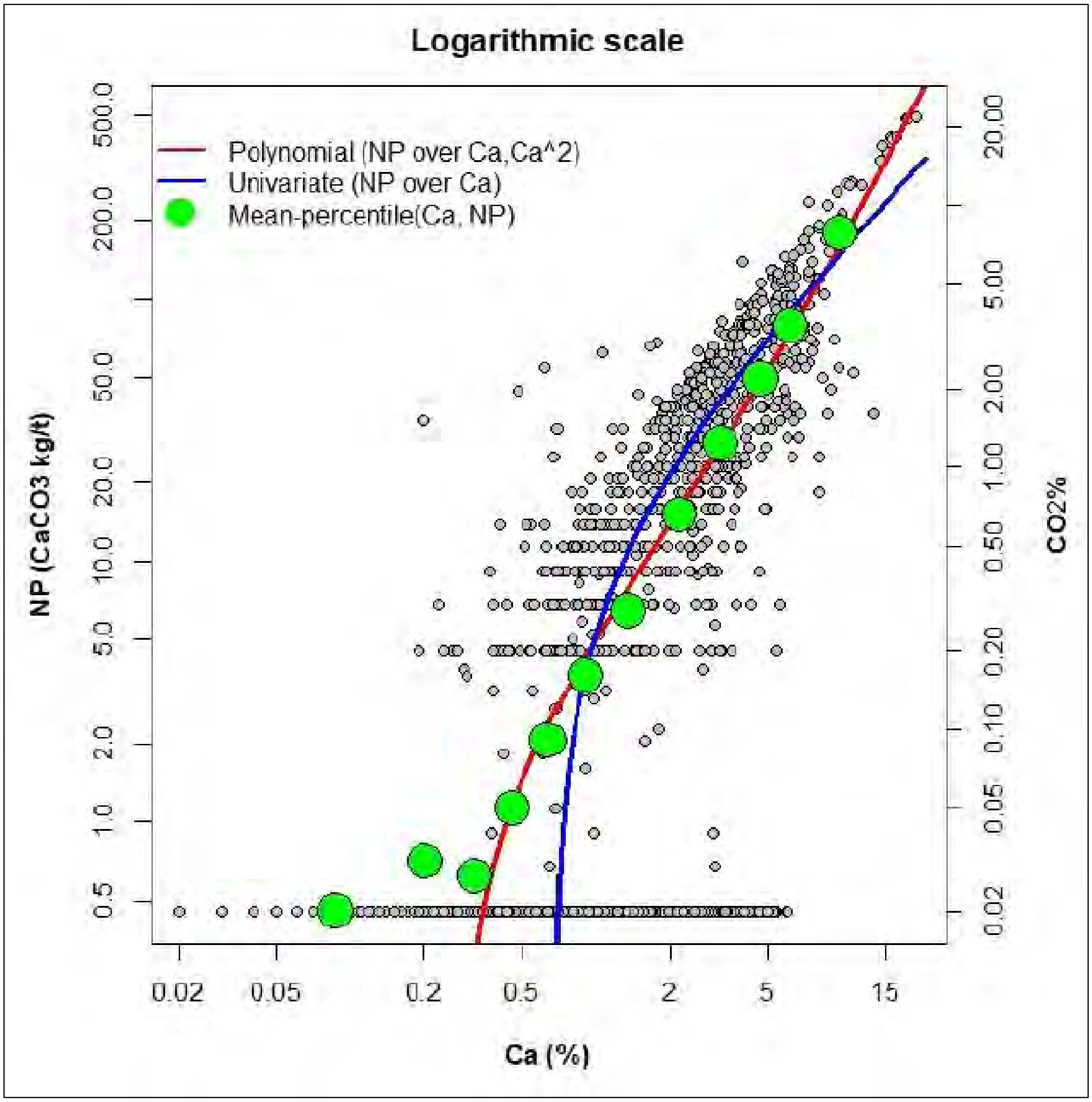
Figure 6-3: Comparison of Neutralization Potential and Total Inorganic Carbon



Source: Kinross

Figure 6-4: Polynomial Quadratic Equation for NP* Using Calcium

6.1.4 Classification of Acid Rock Drainage Potential

Two measures are used to classify ARD potential: the NP*/AP* ratio and sulfide S content.

NP*/AP* Ratio

The recommended ratio for classifying waste rock as potentially acid generating (PAG) is:

- NP*/AP*≤2

Non-PAG (or non-acid generating, NAG) waste rock is classified as:

- NP*/AP*>2

Sulfide S Basis

At low sulfur concentrations, interpretation of ARD potential using NP*/AP* ratios are not meaningful because oxidation of small concentrations of sulfide produces low amounts of acid that can be readily neutralized by silicate minerals in addition to carbonate.

Two lines of evidence were used to develop a sulfide threshold:

- Direct measurement of the paste pH of core samples
- Humidity cell tests

A few paste pH values less than 5 (the pH of water used in the test) are associated with rock containing negligible sulfide and detectable sulfate. This likely reflects natural oxidation processes and indicates that oxide materials have the potential to be weakly acid generating due to leaching of natural oxides. In addition, two humidity cell tests to date have shown weak acid generation for oxide waste rock. To date, there is no indication of acid generation in humidity cells performed on non-oxide low sulfur samples.

On this basis, the recommended use of a sulfur criterion is:

- Oxide materials cannot be classified using a sulfur criterion because they may yield acidity by leaching of natural oxidation minerals. ARD potential of oxide materials is therefore solely defined using NP*/AP* as indicated above.
- For non-oxide materials:
  - NAG is defined by: Sulfide S<0.1% or NP*/AP>2
  - PAG is defined by: Sulfide S≥0.1% and NP*/AP*≤2

The criterion of 0.1% sulfide is generic and based on experience. It appears supported by the HCT data which show active weathering of potassium silicates.

6.1.5 Timing to Onset of Acid Generation

The time or delay to onset of ARD (t_{onset}) depends on both the site-specific availability of reactive NP* and the rate at which reactive NP* (R_{NP*}) is depleted:

$$t_{onset} = NP^* / R_{NP*}$$

However, the rate at which carbonate is depleted is actually a function of the acid generation (sulfide oxidation) rate (R_S). In molar terms, the rate of carbonate depletion to sulfide depletion is the same as the NP/AP criterion for PAG rock ($\{NP^*/AP^*\}_{crit}$):

$$R_{NP*} / R_S = \{NP^*/AP^*\}_{crit}$$

Assuming a direct linear relationship between oxidation rate and sulfur content and conservatively a zero order chemical reaction, then:

$$R_S = k\ AP^*_0$$

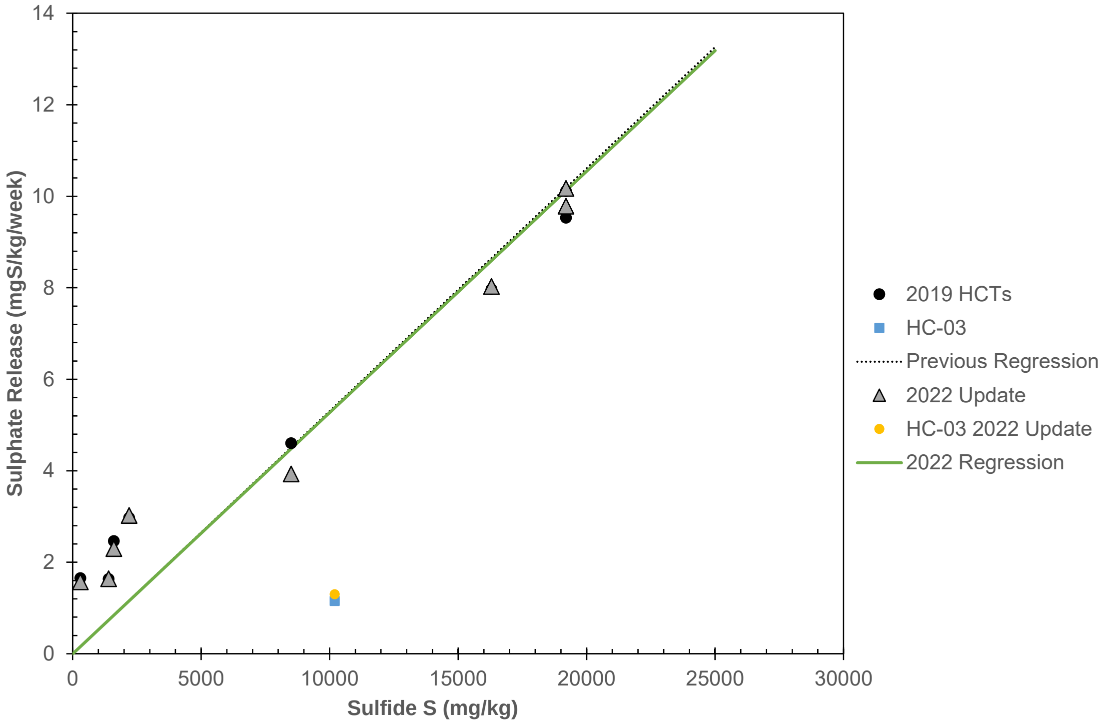
where k is the slope of the line and the rate constant and AP^*_0 is the initial sulfur content of the sample. The non-zero intercept is not included because if no sulfide is present then the rate of sulfide oxidation is zero.

When these three relationships are combined, the delay to onset is:

$$t_{onset} = \frac{\left(NP^*/AP^*\right)_0}{k.\left(NP^*/AP^*\right)_{crit}}$$

Therefore, the delay to onset of ARD is a function of NP*/AP* of the sample and the overall rate of oxidation of sulfide, which is the rate constant (k) multiplied by the NP/AP criterion for PAG rock ($\{NP^*/AP^*\}_{crit}$). Longer delays are indicated for rock with higher NP*/AP* assuming constant values for the two other factors.

k is derived from the relationship between sulfide content and sulfate release shown by the humidity cells that have been running for more than 2 years (Figure 6-5). The regression relationship for these data was calculated using HCTs showing stable SO_4 release rates and excluded the outlier outside the trend. The equation is assumed to pass through the origin because the oxidation rate should be zero in the absence of sulfide. The resulting slope of the regression line is k (0.00053 week^{-1}). Figure 6-5 has been updated to reflect the updated 2022 HCT release rates for the humidity cells that have been running for more than 2 years but the conclusions remain unaltered.



https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 110_DataInfill_BlockModel/[LagTimeCalc_503000.040_ld_mc_rev1.xlsx

Figure 6-5: Relationship between Sulfide Sulfur Content and Average Sulfate Release from Humidity Cells

$(NP^*/AP^*)_{crit}$ is the criterion for PAG materials. For consistency with PAG classification, $(NP^*/AP^*)_{crit}$ is set at 2 to calculate t_{onset}.

The resulting equation linking delay to onset under laboratory conditions is therefore:

$$t_{onset}\text{ (years)} = 18.1 \times (NP^*/AP^*)_{crit}$$

Under site conditions, time to ARD onset would be expected to be longer because cooler temperatures will cause k to be lower than determined by laboratory testing. The above equation therefore represents an upper bound on t_{onset}. For the mine life of 4.5 years, rock with $NP^*/AP^*<0.3$ could generate acid during the mine life. However, k may be an order of magnitude lower and it is more likely that rock with $NP^*/AP^*<0.03$ could generate acid during the short mine life.

6.2 Domaining of Metal Leaching (ML) Potential

6.2.1 Approach

The geochemical characterization study has indicated the potential for neutral pH metals[4] leaching including arsenic, cadmium, copper, antimony, and selenium. Screening level water quality predictions have identified arsenic as the main parameter of concern.

Unlike ARD potential classification with a narrow well-defined “hard line” between lower pHs (usually accelerated metal leaching) and high pH (slower metal leaching) indicated by NP*/AP*, classification of ML potential for NAG waste rock is continuum from low to high ML. Criteria for classification of ML potential are therefore linked to site-specific water quality outcomes. The general expectation is that higher arsenic leaching will be correlated to bulk characteristics, but hard lines are not likely unless there are distinctive mineralogical features.

The mineralogical host of arsenic has a strong influence on its leachability at non-acidic pH (Section 4.1.1). In general, as the As/Fe ratio increases, arsenic leachability also increases.

For sulfide minerals, arsenic associated with arsenopyrite (As/Fe = 1 mol/mol) is more leachable when compared to arsenic associated with pyrite (As/Fe << 1 mol/mol).

For waste rock where sulfides have been fully oxidized (i.e., the oxide zone), arsenic is likely to be associated with residual arsenical ferric iron oxyhydroxides which could include the mineral scorodite ($FeAsO_4$). The expectation is that arsenic mobility will be different for sulfide and oxide materials due to the difference in mineralogical hosts.

Bulk Fe/As is not likely to have meaning when using 4-acid digestions because while arsenic is likely associated with sulfides and secondary oxyhydroxides, iron has numerous mineralogical hosts including silicates which are not arsenic hosts. As/S ratios are used as a proxy for As/Fe recognizing that for oxide materials, S is likely to be depleted relative to As during weathering.

Figure 6-6 shows the relationship between As/S in solids and the rate of arsenic leaching indicated by humidity cell tests, updated to incorporate the latest 2022 HCT data. Results are shown separately for the humidity cells which have been operating for less than two years and older ongoing testing because initial and longer term rates of leaching can be different. The updated results remain consistent with previous conclusions; a positive relationship between bulk As/S and arsenic leaching is indicated and appears to be different for oxide and sulfide samples but with

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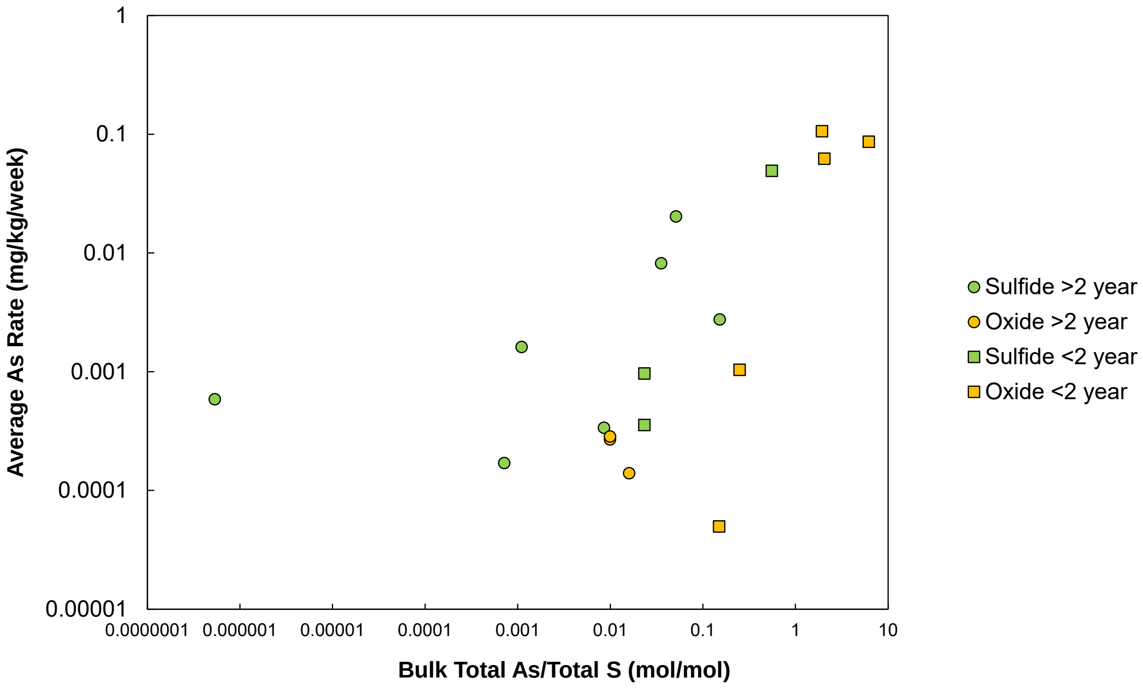
[4] Metals is used as a short form for “heavy trace elements.”

convergence as As/S approaches 1 mol/mol. For oxides, the slope of the relationship is steeper and implies that between As/S of 0.25 mol/mol and 2 mol/mol, arsenic leaching increases sharply.



https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 210 Additional HCTs/HCT/[Tetlin Peak Gold Outcomes 481900.030 rtc rev03.xlsx

Figure 6-6: Bulk Total As/S versus Arsenic Leaching Rate in Humidity Cell Tests

A threshold level for sulfide material is less apparent. The curve steepens (arithmetically) for As/S above 0.04 mol/mol. A threshold of 0.1 mol/mol has been suggested for non-oxide waste rock and can be evaluated for its water quality benefit.

Calculation Methods

SRK understands Kinross has utilized the existing exploration database to assign a concentration of arsenic (mg/kg) and sulfur (%) to each block based on modelled ICP-MS exploration data.

Step 1. Using the modelled arsenic and sulfur concentrations, calculate the molar ratio for each block using the equation below:

$$\mathrm{As(mol)/S\ (mol)} = \left(\frac{\mathrm{ICPAs(mg/kg)}}{74.9}\right) / \left(\frac{\mathrm{ICPS(\%)} \times 10000}{32}\right)$$

Step 2. Classify the block as oxide, transitional or sulfide using the modelled sulfide surface in the block model.

Step 3. Assign the classification of “Metal-Leaching” or “Low Metal” according to the criteria below.

For blocks classified as oxide:

$$\mathrm{As(mol)/S\ (mol)} \geq 1 = \text{“Metal Leaching”}$$

$$\mathrm{As(mol)/S\ (mol)} < 1 = \text{“Low - Metal”}$$

For blocks classified as sulfide or transitional:

$$\text{As(mol)/S (mol)} \geq 0.1 = \text{“Metal Leaching”}$$

$$\text{As(mol)/S (mol)} < 0.1 = \text{“Low - Metal”}$$

As indicated above, metal leaching is a continuum rather than a hard line. These criteria should be revisited using water quality modeling results.

6.3 Waste Classification Criteria Summary

Table 6-1 and Table 6-2 provide summaries of the recommended domains for waste rock management of transition/sulfide materials and oxide materials, respectively for waste rock classification and segregation, as outlined in the mine waste management plan (SRK, 2022).

Table 6-1: Summary of Recommended Domains for Waste Rock Management – Sulfide and Transitional

Domain		Criteria	Potential Refinement	Additional Geochemical Data
PAG	PAG	NP*/AP* ≤2 and S≥0.1%	Refine site specific NP/AP ratio	Mineralogy of HCTs, initiate additional HCTs
	Rapid Onset PAG	NP*/AP* <0.03 and S≥0.1%	Field observations of acidic leachate	On-site barrel testing
NAG	Metal Leaching NAG (ML-NAG)	NP*/AP*>2 or S<0.1%, and As/S≥0.1 mol/mol	Mineralogy (microprobe and SEM) to determine mineralogical host of arsenic, additional HCTs to test range of ratios and arsenic content	Mineralogy of HCTs, initiate additional HCTs
	NAG	NP*/AP*>2 or S<0.1%, and As/S<0.1 mol/mol		

Source: Edited from SRK, 2021b

Table 6-2: Summary of Recommended Domains for Waste Rock Management – Oxide

Domain		Criteria	Potential Refinement	Additional Geochemical Data
PAG	PAG	NP*/AP* ≤2	Refine site specific NP/AP ratio	Mineralogy of HCTs, initiate additional HCTs
	Rapid Onset PAG	NP*/AP* <0.03	Field observations of acidic leachate	On-site barrel testing
NAG	Metal Leaching NAG (ML-NAG)	NP*/AP*>2 and As/S ≥1 mol/mol	Mineralogy (microprobe and SEM) to determine mineralogical host of arsenic, additional HCTs to test range of ratios and arsenic content	Mineralogy of HCTs, initiate additional HCTs
	NAG	NP*/AP*>2 and As/S <1 mol/mol		

Source: Edited from SRK, 2021b

7 Source Term Development

7.1 Introduction

7.1.1 Definition of "Source Term"

"Source terms" refers to predicted concentrations for waters in contact with various types of geologically sourced wastes and surfaces under the expected disposal conditions at the site. For example, the source term for a waste rock storage area is the concentration found in pore waters within the facilities. These predictions become inputs (or terms) to the overall site wide water and load balance model used to assess potential effects of the project on the receiving environment.

The required source terms were developed in consultation with Piteau who are responsible for the site wide water quality model. The sources are:

- Runoff from waste rock dump surfaces during snowmelt
- Runoff from waste rock dump surfaces during summer rainstorms
- Waste rock dump porewaters
- Pit backfill pore waters
- Pit wall runoff
- Infrastructure fill pore waters
- Pit wall runoff for the exposed high walls in Manh Choh South Pit
- Load out pad

7.1.2 Evaluation of Uncertainty

Outputs from source term calculations should be used in a relative rather than absolute sense when drawing conclusions about potential effects on the receiving environment and should be used primarily to inform Project design and the need to add mitigation measures. In general:

- If the Expected Case source terms result in predicted concentrations above guideline levels in the receiving environment, the result is considered likely in the project configuration and additional mitigation, management action or contingencies are probably warranted.
- In contrast, if predicted concentrations are slightly above guidelines for the Upper Bound Case but well below guidelines for the Expected Case, it is considered low probability that actual concentrations will exceed water guidelines and therefore significant design modifications are probably not warranted. Instead, the project should include the ability to monitor contact water and compare predicted versus observed concentrations early in the mine operation.

Regardless of case, the terms were calculated as annual average dissolved concentrations for each year of the mine and do not consider seasonal transient effects such as dilution in contact waters that commonly occurs during snow melt events. Predicted concentrations were calculated on a constant annual basis which is considered conservative.

The resulting source term concentrations presented here should be viewed as "screening level" to evaluate project water quality effects against water quality standards. The results are not geochemical predictions (i.e., they are not ion balanced).

7.2 Source Term Methods

7.2.1 Runoff from Waste Rock Dump Surfaces During Snowmelt

During snowmelt runoff it is expected that waste rock beneath snow will be frozen and that water contact with oxidizing waste rock will be minimal and highly dilute. The chemistry assigned to this water is assumed to be comparable to natural background concentrations.

7.2.2 Runoff from Waste Rock Dump Surfaces During Summer Rainstorms

Normally, low levels of precipitation are expected to result in minimal runoff but high intensity rainfall events may result in runoff to the site surface water collection system. Contact with waste rock is expected to occur during these events. A nominal contact depth of 30 cm was assumed to calculate loading (L) from 1 m^2 of dump surface from these events using the following equation:

$$L\ (mg/m^2) = R\ (mg/kg/week) \times k_{s,WR} \times d_{storm}\ (m) \times 1\ (m^2) \times \rho\ (kg/m^3) \times t_{storm}\ (weeks)$$

Where:

- R is the average rate of weathering indicated by humidity cells.
- k_s is a scaling factor used to account for differences between the laboratory conditions and full scale waste rock.
- d_{storm} is the nominal contact depth.
- ρ is the density of the rock.
- t_{storm} is the time between storm events.

The loading is converted to concentration using

$$C\ (mg/L) = \frac{L(mg/m^2)}{Q_{storm}\ (L/m^2)}$$

Where

- Q is the precipitation during a storm event.

Concentrations obtained by this method were evaluated with respect to solubility constraints indicated by seepage monitoring concentrations indicated by analogous sites. If the calculated concentration exceeded the analog value, the analog value replaces the calculated value whereas if the c is less than the analog value, the calculated value is retained.

7.2.3 Load-Out Pad Run-Off

Load-out pad run-off was calculated using a similar method and equation to waste rock dump run-off:

$$L\ (mg/year) = R\ (mg/kg/week) \times k_{s,WR} \times M\ (kg) \times t\ (weeks/year)$$

$$C\ (mg/L) = \frac{L(mg/year)}{I_{LO}(mm/year) \times A(m^2) \times 0.001(mm/m)}$$

Where

- M is the maximum operating inventory mass for the ROM ore stockpile
- A is the area of the ROM ore stockpile
- I_{LO} is the estimated annual contact water

Concentrations obtained are again compared to analog values to correct for solubility.

7.2.4 Waste Rock Dump Porewaters

Waste rock dump pore water concentrations were calculated using a similar method and equation to the runoff:

$$L\ (\text{mg/year}) = R\ (\text{mg/kg/week}) \times k_{s,WR} \times M\ (\text{kg}) \times t\ (\text{weeks/year})$$

$$C\ (\text{mg/L}) = \frac{L(\text{mg/year})}{I_{WR}(\text{mm/year}) \times A(\text{m}^2) \times 0.001(\text{mm/m})}$$

Where

- M is the mass of waste rock
- A is the area of the dumps
- I_{WR} is the annual average rate of infiltration.

Concentrations obtained are again compared to analog values to correct for solubility.

Pore water concentrations were not calculated separately for each waste rock dump because the infiltration rates are very low and result in pore water chemistry being entirely driven by the analog dataset.

7.2.5 Saturated Pit Backfill Pore Waters

The chemistry of saturated backfill waters reflects the dissolution of oxidation products accumulated prior to saturation. These can include water soluble secondary minerals but also oxides stable under oxidizing conditions but susceptible to reductive dissolution under reducing conditions. For the purpose of this calculation reductive dissolution was not considered because an electron donor (organic carbon) is not expected to be present.

Pore water concentrations were again calculated using the above methods on a per m3 of waste rock basis. The load released by dissolution is:

$$L\ (\text{mg/m}^3) = R\ (\text{mg/kg/week}) \times k_{s,bf} \times 1\ (\text{m}^3) \times \rho\ (\text{kg/m}^3) \times t_{backfill}\ (\text{weeks})$$

In this equation, $t_{backfill}$ is the time frame over which rock weathers before being saturated, The concentration is:

$$C\ (\text{mg/L}) = \frac{L(\text{mg/m}^3)}{1(\text{L/m}^3) \times \phi}$$

Where

- ϕ is backfill porosity.

Concentrations obtained are again compared to analog values to correct for solubility.

7.2.6 Pit Wall Runoff

Pit wall runoff was calculated using similar methods:

$$L\ (\text{mg/m}^{2/}\text{year}) = R\ (\text{mg/kg/week}) \times k_{s,pw} \times d_{wall}\ (\text{m}) \times 1\ (\text{m}^2) \times \rho\ (\text{kg/m}^3) \times t\ (\text{weeks/year})$$

$$C\ (\text{mg/L}) = \frac{L(\text{mg/m}^2/\text{year})}{I_{wall}\ (\text{L/m}^2/\text{year})}$$

Concentrations obtained are again compared to analog values to correct for solubility.

7.2.7 Manh Choh South Pit High Wall Runoff

The Manh Choh South Pit High Wall Runoff was calculated using a similar method to the pit wall runoff but the proportion of PAG and NAG was calculated based upon a 5 m pit wall skin exported from the block model above the 3000 ft (approximately 914 m) elevation.

7.2.8 Infrastructure Fill Pore Waters

Infrastructure fill pore water chemistry is estimated using the same method as waste rock dump pore waters.

7.3 Nitrogen Source Terms

Nitrogen species (nitrate, nitrate, ammonium) were estimated assuming they are derived from explosives residues approximately using the Ferguson and Leask (1988) method. For each tonne of rock mined, the available nitrogen (L_N) for dissolution and leaching into contact waters is estimated from:

$$L_N = PF\ (kg/t) \times f_{AN} \times f_N \times f_R$$

Where

- PF is the explosives powder factor.
- f_{AN} is the fraction of ammonium nitrate in the explosives.
- f_N is the fraction of N in ammonium nitrate indicated by stoichiometry.
- f_R is the fraction of explosives not detonated.

The resulting LN is converted to concentrations using the equations indicated above.

7.4 Inputs

Input values referencing the above parameters are provided in Table 7-1. Specific inputs were provided by Piteau and Peak LLC. Generic values are those based on professional experience.

Table 7-1: Source Term Inputs

Source Term	Parameter	Value	Reference/Assumption
All	R	See Table 7-2	
All	ρ	2,000 kg/m^3	Generic value
Waste Rock	$k_{s,wr}$	0.03	Generic value
	d_{storm}	30 cm	Piteau
	t_{storm}	52 weeks	Annual event
	Q_{storm}	136 mm	Piteau
	I_{WR}	6 mm/year	Piteau
	M	5,044,596 tonnes	Peak LLC
	A	351,301 m^2	Peak LLC
Backfill	$k_{s,wr}$	0.06	Generic value
	$t_{backfill}$	5 years	Mine life + flooding
	ф	0.3	Generic value
Pit Wall	$K_{s,pw}$	0.01	Generic value
	d_{wall}	2 m	Overblast depth
	I_{wall}	140 mm/year	Piteau
Infrastructure	M	2,411,724 tonnes	Peak LLC
	A	106,627 m^2	Peak LLC
Nitrogen Term	PF	0.25 kg/tonne	Peak LLC
	f_{AN}	0.93	Explosives recipe
	f_N	0.35	Stoichiometry
	f_R	2%	Generic

Source: https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 400 Source Terms/2022-08_Source_Term/[Tetlin_InitialWQEstimate_5030000.040_ld_sd_mc_rev04.xlsx]

Average rates from humidity cells tests were used to calculate a range of non-acidic weathering rates based on the assumption that wastes will be managed to prevent the onset of acidification, or that mining will result in locally acid generating materials becoming mixed. To generate source terms, a range of rates was calculated using the 5th, 50th and 95th percentile rates and the proportion of PAG and NAG waste was used to yield a combined rate at each level. Table 7-2 shows selected rates; however, rates are available for all regulated parameters.

The humidity cell rates and source terms were updated for this September 2022 report update. Average arsenic release typically increased in the humidity cell input data for the 2022 update (Table 7-2). This was primarily driven by the availability of new HCT data. The Manh Choh HC-1 to HC-7 results could not be incorporated into the previous source terms as the cells were too recently commissioned to be able to provide meaningful data. The latest results for these new humidity cells have been included in the 2022 update and some of these cells (notably Manh Choh HC-01 and HC-02 skarn oxide, Manh Choh HC-04 calc-schist oxide and Manh Choh HC-06 calc-schist sulfide) reported higher arsenic release rates than previously reported in the older HCTs.

This leads to an increase in some of the arsenic source terms (Table 7-3); the largest increases are seen for the following terms:

- General dump summer run-off P50 has increased by an order of magnitude to 0.3 mg/L)
- General pit wall run-off P50 and P95 have increased by an order of magnitude to 0.7 and 1 mg/L respectively.

Other source terms report either minor increases, no change or a decrease on previous estimations.

Table 7-2: Summary of Selected Average Rates in Humidity Cells

Waste Type	Statistic	SO_4 (mg/kg/wk)	Sb (mg/kg/wk)	As (mg/kg/wk)	Cu (mg/kg/wk)	Se (mg/kg/wk)
NAG	P5	0.29	0.000050	0.0071	0.00019	0.000020
	P50	2.6	0.00018	0.056	0.00023	0.000050
	P95	8.6	0.00024	0.10	0.00075	0.00024
PAG	P5	2.8	0.000010	0.000090	0.00015	0.000030
	P50	11	0.000036	0.00046	0.00029	0.00012
	P95	71	0.00085	0.0052	0.029	0.00067

https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 400 Source Terms/2022-08_Source_Term/[Tetlin_InitialWQEstimate_5030000.040_ld_sd_mc_rev04.xlsx]

Selected analog concentrations are shown in Table 7-3. The concentrations are maximum values in a dataset of several Tintina Zone mines located in Alaska and Yukon Territory and one mine in Nevada. Maximum concentrations in humidity cell leachates from this project were also included where these exceeded maximum concentrations from the analog mines. It is intended that these values will be replaced with site specific knowledge as leach tests and on-site kinetic tests are monitored.

Table 7-3: Selected Analog Concentrations

Parameter	Value (mg/L)
SO_4	1,800
As	1.4
Cu	0.07
Se	0.11
Sb	1.4

Source: https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 400 Source Terms/2022-08_Source_Term/[Tetlin_InitialWQEstimate_5030000.040_ld_sd_mc_rev04.xlsx]

Background water chemistry used for the waste rock dump snowmelt term is the maximum of average observed concentrations in Hillside Creek, Tors Creek and Black Creek.

7.5 Results

Source term outputs are provided in Table 7-4.

Table 7-4: Summary of Selected Source Terms – Annual Concentrations

Term	Rate Percentile Case	SO_4 (mg/L)	NO_3 (mg N/L)	Sb (mg/L)	As (mg/L)	Se (mg/L)
General dump snowmelt runoff	5%	60	0.6	0.0002	0.007	0.0007
General dump snowmelt runoff	50%	60	0.6	0.0002	0.007	0.0007
General dump snowmelt runoff	95%	60	0.6	0.0002	0.007	0.0007
General dump summer runoff	5%	5	6	0.0003	0.04	0.0002
General dump summer runoff	50%	30	6	0.001	0.3	0.0004
General dump summer runoff	95%	100	6	0.002	0.6	0.002
General dump porewater	5%	2000	5000	0.3	1	0.1
General dump porewater	50%	2000	5000	0.9	1	0.1
General dump porewater	95%	2000	5000	1	1	0.1
General backfill porewater	5%	300	10	0.001	0.009	0.003
General backfill porewater	50%	1000	10	0.004	0.05	0.01
General backfill porewater	95%	2000	10	0.09	0.5	0.07
General pit wall runoff	5%	10	40	0.0006	0.09	0.0003
General pit wall runoff	50%	60	40	0.002	0.7	0.0009
General pit wall runoff	95%	300	40	0.005	1	0.005
Infrastructure pore water	5%	900	3000	0.2	1	0.06
Infrastructure pore water	50%	2000	3000	0.5	1	0.1
Infrastructure pore water	95%	2000	3000	0.7	1	0.1
High wall pit wall runoff	5%	20	40	0.0005	0.06	0.0004
High wall pit wall runoff	50%	90	40	0.002	0.5	0.001
High wall pit wall runoff	95%	500	40	0.007	0.9	0.006
Loadout pad runoff	5%	90	100	0.005	0.7	0.003
Loadout pad runoff	50%	500	100	0.02	1	0.007
Loadout pad runoff	95%	2000	100	0.04	1	0.04

https://srk.sharepoint.com/sites/NA503000.040/Internal/Task 400 Source Terms/2022-08_Source_Term/[Tetlin_InitialWQEstimate_5030000.040_ld_sd_mc_rev04.xlsx]

Notes: All concentrations are shown to 1 significant figure.
Trace element concentrations are “dissolved”.

8 Signature Page

This report, Manh Choh Project Geochemical Characterization, was prepared by

Prepared by

Melanie Cox, BSc, FGS
Senior Consultant (Geochemistry)

Reviewed by

S. J. DAY

Nov 10, 2022

Stephen Day, PGeo (British Columbia)
Corporate Consultant (Geochemistry)

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

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Appendix A: Mineralogy Reports

Appendix A1: Mineralogy Reports Waste Rock (Historical)

BV Minerals - Metallurgical Division
Bureau Veritas Commodities Canada Ltd.
11620 Horseshoe Way,
Richmond, BC V7A 4V5 Canada
Tel: +1(604) 272-8110 Fax: +1(604) 272-0851
Email: wendy.ma@ca.bureauveritas.com

July 5, 2019

Bonnie Tsang
Analyst, Acid Rock Drainage
Bureau Veritas Laboratories
4606 Canada Way,
Burnaby, BC Canada V5G 1K5

Re: Mineralogical Assessment of the Ten Test Samples
Proposal No. ME1902605 – Royal Gold Project

Dear Ms. Tsang,

We have completed the mineralogical assessment on the ten test samples that you provided. This set of ten test samples was generated from the environmental tests for Royal Gold Inc. at BV Laboratories - Burnaby. The list of these ten samples for analysis is show in the table below.

SAMPLE RECEIVING LOG SHEET

Count	Sample Label	BV Laoratories Code
1	18	VP2023
2	PK19001	VP2024
3	PK19002	VP2025
4	P578884	VP2026
5	PK19004	VP2027
6	PK19005	VP2028
7	14	VP2029
8	8	VP2030
9	P578870	VP2031
10	P578870 Dup	VP2032

The principal objective of this study was to identify and quantify the mineral abundances of the provided ten test samples. To achieve the program, the standard chemical analysis, X-Ray Diffraction (XRD) and QEMSCAN Bulk Mineral Analysis (BMA) protocols were conducted on each of the unsized test samples as received. All the information produced by this study are shown in three appendices attached at the end of this letter.

Appendix I – Sample Origin and Methodology
Appendix II – QEMSCAN Particle Mineral Analysis (PMA) Data
Appendix III – X-Ray Diffraction (XRD) Analysis Data

The data, in terms of the mineral compositions and the sulphur deportment data, of the ten test samples are summarized in Table 1 to 2 and Figure 1 on the following pages of this letter.

Thank you for inviting BV Minerals – Metallurgical Division to participate in this mineralogical testing program. If you have any questions regarding this study or our assessment of the data, please do not hesitate to contact us.

Kind regards,

Wendy Ma, M.Sc. P. Geo.
Mineralogy Manager

TABLE 1
CHEMICAL COMPOSITIONS OF THE TEN TEST SAMPLES

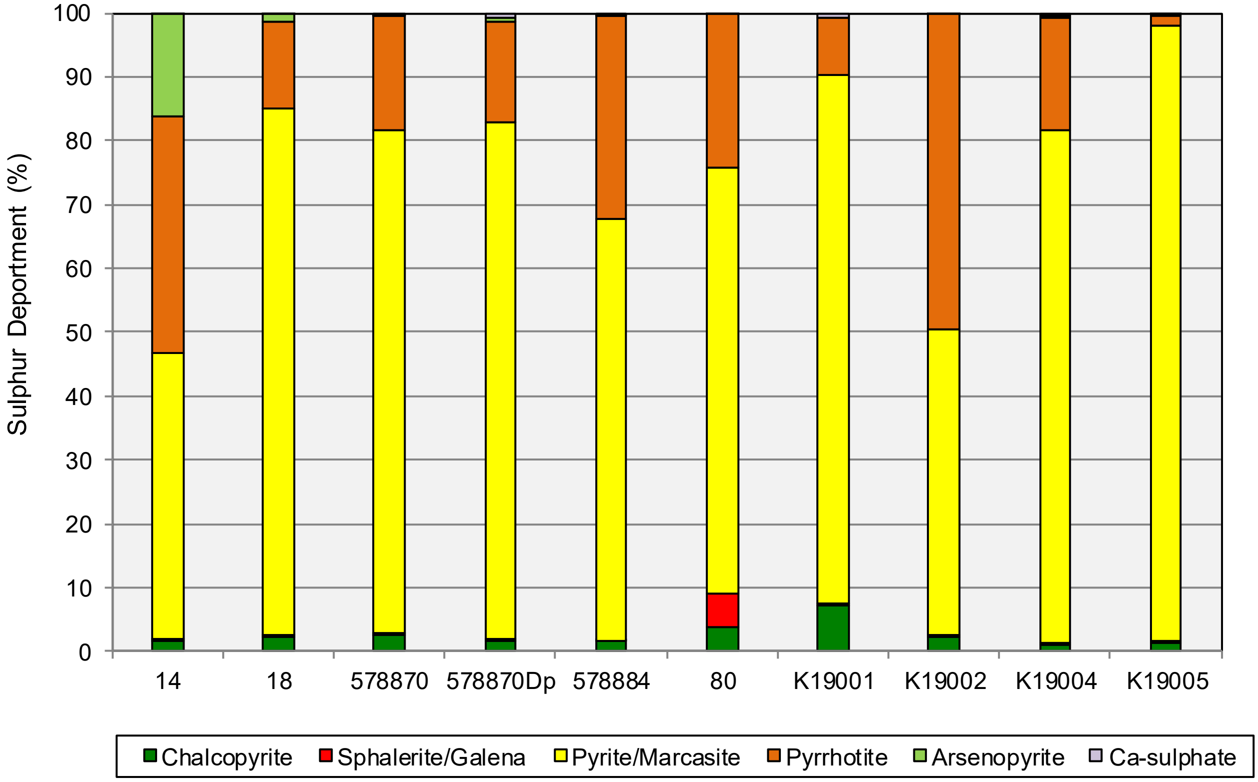
Element	Symbol	14	18	578870	578870 Dp	578884	80	K19001	K19002	K19004	K19005
Iron	Fe	4.29	7.46	9.00	8.98	3.09	5.46	5.18	3.88	3.76	3.36
Sulphur	S (t)	0.13	0.79	1.36	1.67	0.27	0.13	1.57	0.83	0.37	0.10
Silicon	Si	30.4	27.3	25.8	26.1	34.0	26.2	30.7	31.7	31.4	29.0
Aluminum	Al	7.09	7.84	7.04	7.03	6.24	11.20	5.61	5.43	7.43	7.43
Calcium	Ca	3.33	3.04	4.90	4.67	1.33	0.87	3.19	4.19	1.68	2.89

TABLE 2
MINERAL COMPOSITIONS OF THE TEN TEST SAMPLES

Minerals	14	18	578870	578870 Dp	578884	80	K19001	K19002	K19004	K19005
Chalcopyrite	0.01	0.05	0.10	0.10	0.01	0.01	0.35	0.05	0.02	0.02
Sphalerite/Galena	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.00
Pyrite/Marcasite	0.15	1.21	1.96	3.13	0.20	0.09	2.62	0.67	0.80	0.19
Pyrrhotite	0.17	0.28	0.63	0.86	0.14	0.05	0.41	0.98	0.25	0.00
Arsenopyrite	0.14	0.05	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00
Total Sulphides	**0.47**	**1.60**	**2.70**	**4.17**	**0.35**	**0.15**	**3.39**	**1.70**	**1.08**	**0.21**
Iron Oxides	0.5	1.9	1.5	1.4	0.3	0.2	1.0	0.2	0.4	0.7
Ilmenite	0.1	0.3	0.2	0.3	0.3	1.1	0.0	0.3	0.1	0.0
Quartz	32.4	24.2	24.1	24.2	51.6	27.8	45.7	41.9	42.7	22.5
K-Feldspars	8.8	18.4	22.9	22.3	3.2	2.9	18.3	15.0	8.5	38.2
Plagioclase Feldspar	26.9	20.4	12.8	11.7	12.2	16.4	4.6	16.9	14.9	12.1
Muscovite/Illite	11.2	11.4	11.1	11.9	18.7	34.4	10.1	4.0	18.0	7.5
Chlorite	7.1	8.8	7.8	8.3	5.9	11.5	6.6	4.8	4.7	4.5
Amphibole (Actinolite)	2.7	3.3	5.4	5.3	1.3	0.2	1.1	3.0	3.4	4.7
Calcite/Dolomite	2.6	1.2	3.7	3.2	1.0	0.0	4.8	1.6	0.4	2.7
Almandine	2.6	2.9	2.5	2.4	1.4	1.7	1.6	1.9	1.5	1.2
Biotite/Phlogopite	1.9	2.2	1.6	1.5	1.9	1.6	0.3	0.4	2.2	2.7
Sphene/Titanite	1.5	1.4	1.7	1.5	0.8	0.9	0.7	7.4	1.1	1.5
Pyroxene (Diopside)	0.4	0.2	0.5	0.5	0.3	0.1	0.3	0.2	0.3	0.6
'Kaolinite' (clay)	0.2	0.6	0.1	0.2	0.3	0.6	0.9	0.1	0.2	0.3
Others	0.5	1.4	1.2	1.1	0.3	0.5	0.6	0.5	0.6	0.5
Total	100	100	100	100	100	100	100	100	100	100

Notes: 1)) Iron Oxides include Geothite, Limonite, Siderite, Jarosite, Magnetite and Iron Metal.
2) Others include trace amounts of Apatite, Rutile/Anatase, Zircon/Barite, Ca-sulphate, and unresolved mineral species. See Appendix II for details.

FIGURE 1
SULPHUR DEPORTMENTS OF THE TEN TEST SAMPLES



MINERALOGICAL ASSESSMENTS OF TEN TEST SAMPLES

APPENDIX I

SAMPLE ORIGIN AND METHDOLOGY

JULY 5, 2019

1. Sample Origin and Methodology:

A total of ten test samples were received at the BV Minerals - Metallurgical Division in Canada for the mineralogical assessment on May 7, 2019. This set of test samples for analysis was generated from the environmental tests for Royal Gold Inc. at BV Laboratories - Burnaby. The sample list is show in the table below.

SAMPLE RECEIVING LOG SHEET

Count	Sample Label	BV Laoratories Code
1	18	VP2023
2	PK19001	VP2024
3	PK19002	VP2025
4	P578884	VP2026
5	PK19004	VP2027
6	PK19005	VP2028
7	14	VP2029
8	8	VP2030
9	P578870	VP2031
10	P578870 Dup	VP2032

Upon receipt of the samples, the representative cuts were taken from each of the ten test sample for the chemical analysis and mineralogical studies. The standard chemical analysis protocols, as well as the X-Ray Diffraction (XRD) Analysis, were performed on each of the test samples as received, to assist the calibrations of QEMSCAN analysis. Results of the chemical analysis can be located at the end of Appendix I. The XRD data can be located in Appendix III.

Each of the unsized samples as received was mounted into the 30mm blocks using epoxy. During the mounting, graphite was also added into each sample block in order to decrease the particle touching and the settlement of mineral particles with relatively high specific gravity. The mounted sample blocks were ground, polished and carbon coated using the standard QEMSCAN sample preparation procedures.

Following the sample preparation, the QEMSCAN Bulk Mineral Analysis (BMA) was conducted on each of the unsized samples. The SIP (Specific Identification Protocols) was particularly developed for this set of samples, to identify and quantify the mineral compositions of these test samples.

The data generated using QEMSCAN Bulk Mineral Analysis (BMA) can be located in Appendix II.

MINERALOGICAL ASSESSMENTS OF TEN TEST SAMPLES

APPENDIX II

QEMSCAN BULK MINERAL ANALYSIS (BMA) DATA

JULY 5, 2019

TABLE 1A
MINERAL COMPOSITION OF THE TEST SAMPLES
ME1902605

Minerals	14	18	578870	578870Dp	578884
Chalcopyrite	<0.1	0.1	0.1	0.1	<0.1
Sphalerite/Galena	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrite/Marcasite	0.1	1.2	2.0	3.1	0.2
Pyrrhotite	0.2	0.3	0.6	0.9	0.1
Arsenopyrite	0.1	0.1	<0.1	0.1	<0.1
Iron Oxides	0.5	1.9	1.5	1.4	0.3
Ilmenite	0.1	0.3	0.2	0.3	0.3
Quartz	32.4	24.2	24.1	24.2	51.6
K-Feldspars	8.8	18.4	22.9	22.3	3.2
Plagioclase Feldspar	26.9	20.4	12.8	11.7	12.2
Muscovite/Illite	11.2	11.4	11.1	11.9	18.7
Chlorite	7.1	8.8	7.8	8.3	5.9
Amphibole (Actinolite)	2.7	3.3	5.4	5.3	1.3
Calcite	2.6	1.1	3.5	3.1	0.9
Almandine	2.6	2.9	2.5	2.4	1.4
Biotite/Phlogopite	1.9	2.2	1.6	1.5	1.9
Sphene/Titanite	1.5	1.4	1.7	1.5	0.8
Pyroxene (Diopside)	0.4	0.2	0.5	0.5	0.3
'Kaolinite' (clay)	0.2	0.6	0.1	0.2	0.3
Apatite	0.3	0.2	0.2	0.2	0.1
Rutile/Anatase	<0.1	0.1	<0.1	<0.1	0.1
Dolomite	<0.1	<0.1	0.2	0.1	<0.1
Zircon/Barite	<0.1	0.1	0.1	0.1	<0.1
Ca-sulphate	<0.1	<0.1	<0.1	0.1	<0.1
Others	0.2	1.0	0.9	0.7	0.1
Total	100	100	100	100	100

Note: 1) Iron Oxides include Geothite, Limonite, Siderite, Jarosite, Magnetite and Iron Metal.
2) Others includes trace amounts of Corundum/Diaspore and unresolved mineral species.

TABLE 1A Continued
MINERAL COMPOSITION OF THE TEST SAMPLES
ME1902605

Minerals	80	K19001	K19002	K19004	K19005
Chalcopyrite	<0.1	0.3	<0.1	<0.1	<0.1
Sphalerite/Galena	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrite/Marcasite	0.1	2.6	0.7	0.8	0.2
Pyrrhotite	<0.1	0.4	1.0	0.3	<0.1
Arsenopyrite	<0.1	<0.1	<0.1	<0.1	<0.1
Iron Oxides	0.2	1.0	0.2	0.4	0.7
Ilmenite	1.1	<0.1	0.3	0.1	<0.1
Quartz	27.8	45.7	41.9	42.7	22.5
K-Feldspars	2.9	18.3	15.0	8.5	38.2
Plagioclase Feldspar	16.4	4.6	16.9	14.9	12.1
Muscovite/Illite	34.4	10.1	4.0	18.0	7.5
Chlorite	11.5	6.6	4.8	4.7	4.5
Amphibole (Actinolite)	0.2	1.1	3.0	3.4	4.7
Calcite	<0.1	4.7	1.6	0.4	2.7
Almandine	1.7	1.6	1.9	1.5	1.2
Biotite/Phlogopite	1.6	0.3	0.4	2.2	2.7
Sphene/Titanite	0.9	0.7	7.4	1.1	1.5
Pyroxene (Diopside)	0.1	0.3	0.2	0.3	0.6
'Kaolinite' (clay)	0.6	0.9	0.1	0.2	0.3
Apatite	0.3	0.2	0.2	0.3	0.2
Rutile/Anatase	0.1	0.2	0.1	0.1	0.1
Dolomite	<0.1	0.1	<0.1	<0.1	<0.1
Zircon/Barite	<0.1	<0.1	0.1	<0.1	<0.1
Ca-sulphate	<0.1	<0.1	<0.1	<0.1	<0.1
Others	0.1	0.2	0.1	0.2	0.2
Total	100	100	100	100	100

Note: 1) Iron Oxides include Geothite, Limonite, Siderite, Jarosite, Magnetite and Iron Metal.
2) Others includes trace amounts of Corundum/Diaspore and unresolved mineral species.

TABLE 1B
DISTRIBUTION OF SULPHUR BEARING MINERALS
14

Mineral	Assays Wt. %	% Sulphur Bearing Mineral	% Sulphur Bearing Mineral of Total Sulphur
Chalcopyrite	<0.1	1.7	1.5
Sphalerite/Galena	<0.1	0.6	0.5
Pyrite/Marcasite	0.1	31.0	44.8
Pyrrhotite	0.2	36.1	36.9
Arsenopyrite	0.1	30.5	16.2
Ca-sulphate	<0.1	0.1	0.1
Total	0.5	100	100

DISTRIBUTION OF SULPHUR BEARING MINERALS
18

Mineral	Assays Wt. %	% Sulphur Bearing Mineral	% Sulphur Bearing Mineral of Total Sulphur
Chalcopyrite	0.1	3.2	2.2
Sphalerite/Galena	<0.1	0.5	0.3
Pyrite/Marcasite	1.2	75.0	82.4
Pyrrhotite	0.3	17.6	13.6
Arsenopyrite	0.1	3.2	1.3
Ca-sulphate	<0.1	0.4	0.2
Total	1.6	100	100

DISTRIBUTION OF SULPHUR BEARING MINERALS
578870

Mineral	Assays Wt. %	% Sulphur Bearing Mineral	% Sulphur Bearing Mineral of Total Sulphur
Chalcopyrite	0.1	3.8	2.7
Sphalerite/Galena	<0.1	0.3	0.1
Pyrite/Marcasite	2.0	71.9	78.8
Pyrrhotite	0.6	23.3	18.0
Arsenopyrite	<0.1	0.1	0.1
Ca-sulphate	<0.1	0.6	0.3
Total	2.7	100	100

TABLE 1B Continued
DISTRIBUTION OF SULPHUR BEARING MINERALS
578870Dp

Mineral	Assays Wt. %	% Sulphur Bearing Mineral	% Sulphur Bearing Mineral of Total Sulphur
Chalcopyrite	0.1	2.5	1.7
Sphalerite/Galena	<0.1	0.1	0.1
Pyrite/Marcasite	3.1	74.1	81.1
Pyrrhotite	0.9	20.3	15.6
Arsenopyrite	0.1	1.8	0.7
Ca-sulphate	0.1	1.2	0.7
Total	4.2	100	100

DISTRIBUTION OF SULPHUR BEARING MINERALS
578884

Mineral	Assays Wt. %	% Sulphur Bearing Mineral	% Sulphur Bearing Mineral of Total Sulphur
Chalcopyrite	<0.1	2.1	1.5
Sphalerite/Galena	<0.1	0.2	0.1
Pyrite/Marcasite	0.2	57.3	66.0
Pyrrhotite	0.1	39.4	32.0
Arsenopyrite	<0.1	0.1	0.1
Ca-sulphate	<0.1	0.8	0.4
Total	0.3	100	100

DISTRIBUTION OF SULPHUR BEARING MINERALS
80

Mineral	Assays Wt. %	% Sulphur Bearing Mineral	% Sulphur Bearing Mineral of Total Sulphur
Chalcopyrite	<0.1	5.1	3.7
Sphalerite/Galena	<0.1	7.6	5.3
Pyrite/Marcasite	0.1	57.6	66.8
Pyrrhotite	<0.1	29.4	24.1
Arsenopyrite	0.0	0.0	0.0
Ca-sulphate	<0.1	0.3	0.2
Total	0.1	100	100

TABLE 1B Continued
DISTRIBUTION OF SULPHUR BEARING MINERALS
K19001

Mineral	Assays Wt. %	% Sulphur Bearing Mineral	% Sulphur Bearing Mineral of Total Sulphur
Chalcopyrite	0.3	10.2	7.2
Sphalerite/Galena	<0.1	0.3	0.2
Pyrite/Marcasite	2.6	76.6	82.9
Pyrrhotite	0.4	11.9	9.1
Arsenopyrite	0.0	0.0	0.0
Ca-sulphate	<0.1	1.1	0.6
Total	3.4	100	100

DISTRIBUTION OF SULPHUR BEARING MINERALS
K19002

Mineral	Assays Wt. %	% Sulphur Bearing Mineral	% Sulphur Bearing Mineral of Total Sulphur
Chalcopyrite	<0.1	2.8	2.2
Sphalerite/Galena	<0.1	0.6	0.5
Pyrite/Marcasite	0.7	39.2	47.9
Pyrrhotite	1.0	57.2	49.3
Arsenopyrite	0.0	0.0	0.0
Ca-sulphate	<0.1	0.2	0.2
Total	1.6	100	100

DISTRIBUTION OF SULPHUR BEARING MINERALS
K19004

Mineral	Assays Wt. %	% Sulphur Bearing Mineral	% Sulphur Bearing Mineral of Total Sulphur
Chalcopyrite	<0.1	1.5	1.1
Sphalerite/Galena	<0.1	0.5	0.4
Pyrite/Marcasite	0.8	73.6	80.3
Pyrrhotite	0.3	23.0	17.7
Arsenopyrite	<0.1	0.2	0.1
Ca-sulphate	<0.1	1.2	0.5
Total	1.1	100	100

TABLE 1B Continued
DISTRIBUTION OF SULPHUR BEARING MINERALS
K19005

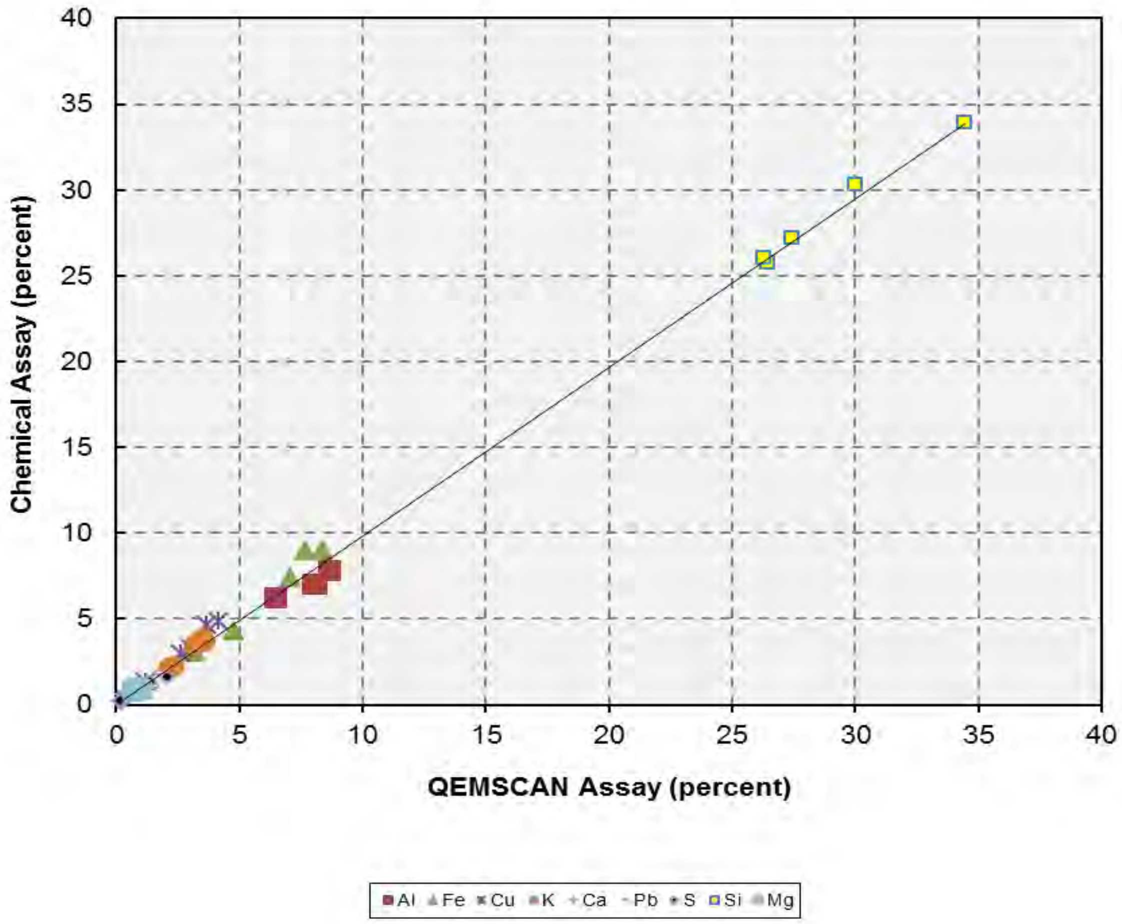
Mineral	Assays Wt. %	% Sulphur Bearing Mineral	% Sulphur Bearing Mineral of Total Sulphur
Chalcopyrite	<0.1	8.1	1.3
Sphalerite/Galena	<0.1	0.7	0.4
Pyrite/Marcasite	0.2	88.2	96.3
Pyrrhotite	<0.1	1.8	1.4
Arsenopyrite	<0.1	0.9	0.3
Ca-sulphate	<0.1	0.4	0.2
Total	0.2	100	100

TABLE 1C
ASSAY RESULTS AND RECONCILIATION
ME1902605

Element	Assay Methods	14	18	578870	578870Dp	578884
Al	QEMSCAN	7.97	8.65	8.06	8.06	6.44
	Chemical	7.09	7.84	7.04	7.03	6.24
Ca	QEMSCAN	0.31	0.22	0.50	0.43	0.11
	Chemical	0.59	0.22	0.80	0.76	0.24
Cu	QEMSCAN	3.03	2.62	4.17	3.64	1.20
	Chemical	3.33	3.04	4.90	4.67	1.33
Fe	QEMSCAN	4.72	7.07	7.63	8.38	3.18
	Chemical	4.29	7.46	9.00	8.98	3.09
K	QEMSCAN	2.13	3.13	3.50	3.51	2.30
	Chemical	2.11	3.55	3.87	3.74	2.27
Mg	QEMSCAN	0.72	0.82	0.79	0.78	0.97
	Chemical	0.86	0.89	0.96	0.9	0.93
Pb	QEMSCAN	1.64	1.23	0.76	0.75	0.82
	Chemical	1.95	1.15	0.54	0.54	1.00
S	QEMSCAN	0.17	0.78	1.33	2.06	0.16
	Chemical	0.13	0.79	1.36	1.67	0.27
Si	QEMSCAN	30.0	27.4	26.4	26.2	34.4
	Chemical	30.4	27.3	25.8	26.1	34.0
Ti	QEMSCAN	0.51	0.52	0.59	0.59	0.52
	Chemical	0.36	0.37	0.37	0.37	0.31

Element	Assay Methods	80	K19001	K19002	K19004	K19005
Al	QEMSCAN	10.5	5.68	6.14	7.23	7.96
	Chemical	11.2	5.61	5.43	7.43	7.43
Ca	QEMSCAN	0.01	0.59	0.19	0.06	0.30
	Chemical	0.07	1.00	0.45	0.14	0.48
Cu	QEMSCAN	1.21	2.34	4.37	1.61	2.61
	Chemical	0.87	3.19	4.19	1.68	2.89
Fe	QEMSCAN	5.18	5.23	4.23	3.92	3.74
	Chemical	5.46	5.18	3.88	3.76	3.36
K	QEMSCAN	3.70	2.84	1.94	2.81	4.91
	Chemical	3.50	3.29	2.37	3.09	5.15
Mg	QEMSCAN	0.98	0.29	0.64	1.05	1.42
	Chemical	1.51	0.72	0.71	1.06	1.44
Pb	QEMSCAN	0.77	0.57	0.70	1.06	1.37
	Chemical	1.31	0.36	0.64	1.14	0.92
S	QEMSCAN	0.07	1.69	0.75	0.54	0.10
	Chemical	0.13	1.57	0.83	0.37	0.10
Si	QEMSCAN	28.0	31.9	31.4	32.6	29.4
	Chemical	26.2	30.7	31.7	31.4	29.0
Ti	QEMSCAN	0.74	0.38	1.68	0.46	0.49
	Chemical	0.50	0.20	1.48	0.35	0.35

TABLE 1C
ASSAY RESULTS AND RECONCILIATION
ME1902605



MINERALOGICAL ASSESSMENTS OF TEN TEST SAMPLES

APPENDIX III

X-RAY DIFFRACTION (XRD) ANALYSIS DATA

JULY 5, 2019

QUANTITATIVE PHASE ANALYSIS OF 10 POWDER SAMPLES USING THE RIETVELD METHOD AND X-RAY POWDER DIFFRACTION DATA.

Project: Royal Gold – Tetlin HCT
B931765

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June 5, 2019

EXPERIMENTAL METHOD

The ten samples of **Project Royal Gold – Tetlin HCT** were reduced to the optimum grain-size range for quantitative X-ray analysis (<10 μm) by grinding under ethanol in a vibratory McCrone Micronizing Mill for 10 minutes. Continuous-scan X-ray powder-diffraction data were collected over a range 3-80°2θ with CoKα radiation on a Bruker D8 Advance Bragg-Brentano diffractometer equipped with an Fe monochromator foil, 0.6 mm (0.3°) divergence slit, incident- and diffracted-beam Soller slits and a LynxEye-XE detector. The long fine-focus Co X-ray tube was operated at 35 kV and 40 mA, using a take-off angle of 6°.

RESULTS

The X-ray diffractograms were analyzed using the International Centre for Diffraction Database PDF-4 and Search-Match software by Bruker. X-ray powder-diffraction data of the samples were refined with Rietveld program Topas 4.2 (Bruker AXS). The results of quantitative phase analysis by Rietveld refinements are given in Table 1 (separate file, ***Maxxam Analytics Results June 5 2019 – Project Royal Gold – Tetlin HCT B931765 – 10 samples.xlsx***). These amounts represent the relative amounts of crystalline phases normalized to 100%. Ideal formulae for the minerals are given in Table 2. The Rietveld refinement plots are shown in Figures 1 – 10.

Note that samples in Figures 1, 2, 9 and 10 contain unknown clay minerals, likely interstratified chlorite-smectite which could not be analyzed (see small humps fitted with calculated peaks). Also, for the sample shown in Figure 6, an empirical montmorillonite structure model has been fitted as an approximation to account for the hump at about 7º2θ. Therefore, the results should be considered semi-quantitative.

Table 2.

Mineral	**Ideal Formula**
Actinolite	$\square\{Ca_2\}\{Mg_{4.5-2.5}Fe_{0.5-2.5}\}(Si_8O_{22})(OH)_2$
Almandine	$Fe^{2+}{}_3Al_2(SiO_4)_3$
Biotite	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$
Calcite	$CaCO_3$
Clinochlore	$(Mg,Fe^{2+})_5Al(Si_3Al)O_{10}(OH)_8$
Diopside	$CaMgSi_2O_6$
Dolomite	$CaMg(CO_3)_2$
Ferro-actinolite	$Ca_2(Fe^{2+},Mg)_5(OH)_2Si_8O_{22}$
Gypsum	$CaSO_4 \cdot 2H_2O$
Hematite	$\alpha\text{-}Fe_2O_3$
Ilmenite	$Fe^{2+}TiO_3$
Kaolinite	$Al_2Si_2O_5(OH)_4$
K-Feldspar (Orthoclase)	$KAlSi_3O_8$
Marcasite	FeS_2
Marialite	$Na_4Al_3Si_9O_{24}Cl$
Montmorillonite	$(Na,Ca)_{0.3}(Al,Mg)_2Si_4O_{10}(OH)_2 \cdot nH_2O$
Muscovite 2M1	$KAl_2(AlSi_3O_{10})(OH)_2$
Plagioclase	$NaAlSi_3O_8 – CaAl_2Si_2O_8$
Pyrite	FeS_2
Pyrrhotite	$Fe_{1-x}S$
Quartz	SiO_2
Titanite	$CaTiSiO_5$

Figure 1. Rietveld refinement plot of sample **Maxxam Analytics 1_18_VP2023** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

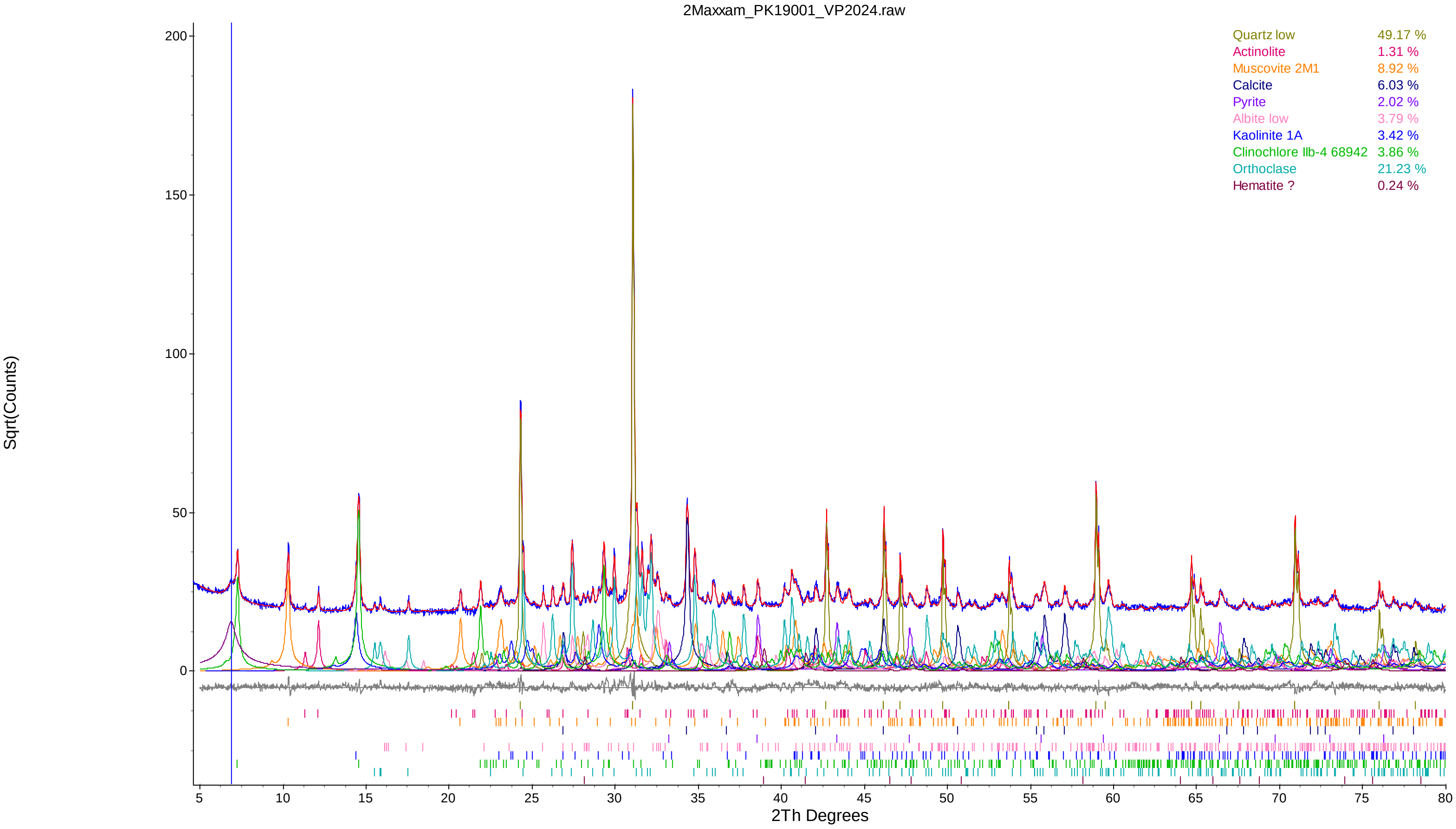

Figure 2. Rietveld refinement plot of sample **Maxxam Analytics 2_PK19001_VP2024** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

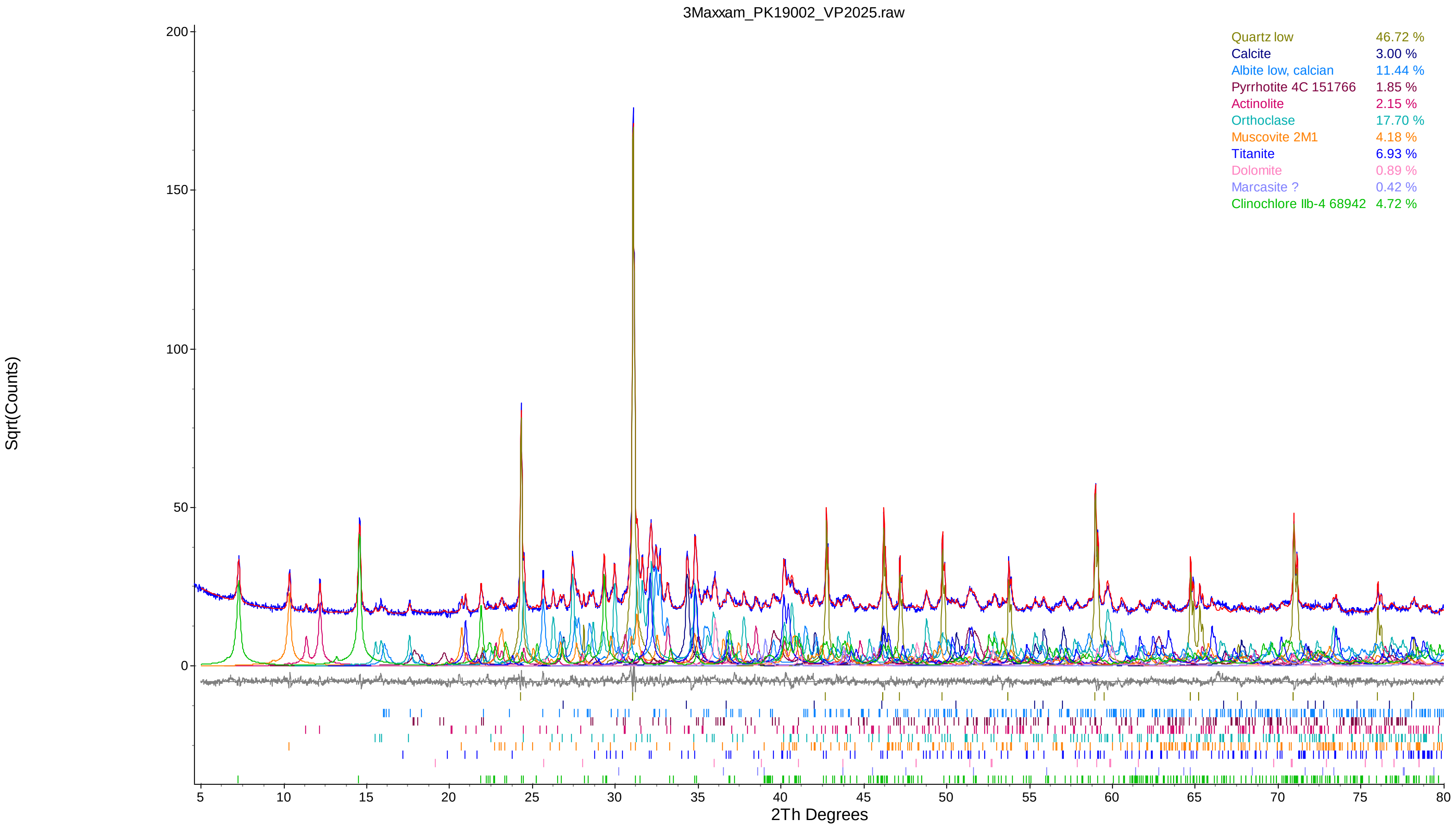

Figure 3. Rietveld refinement plot of sample **Maxxam Analytics 3_PK19002_VP2025** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

Figure 4. Rietveld refinement plot of sample **Maxxam Analytics 4_P578884_VP2026** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

Figure 5. Rietveld refinement plot of sample **Maxxam Analytics 5_PK19004_VP2027** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

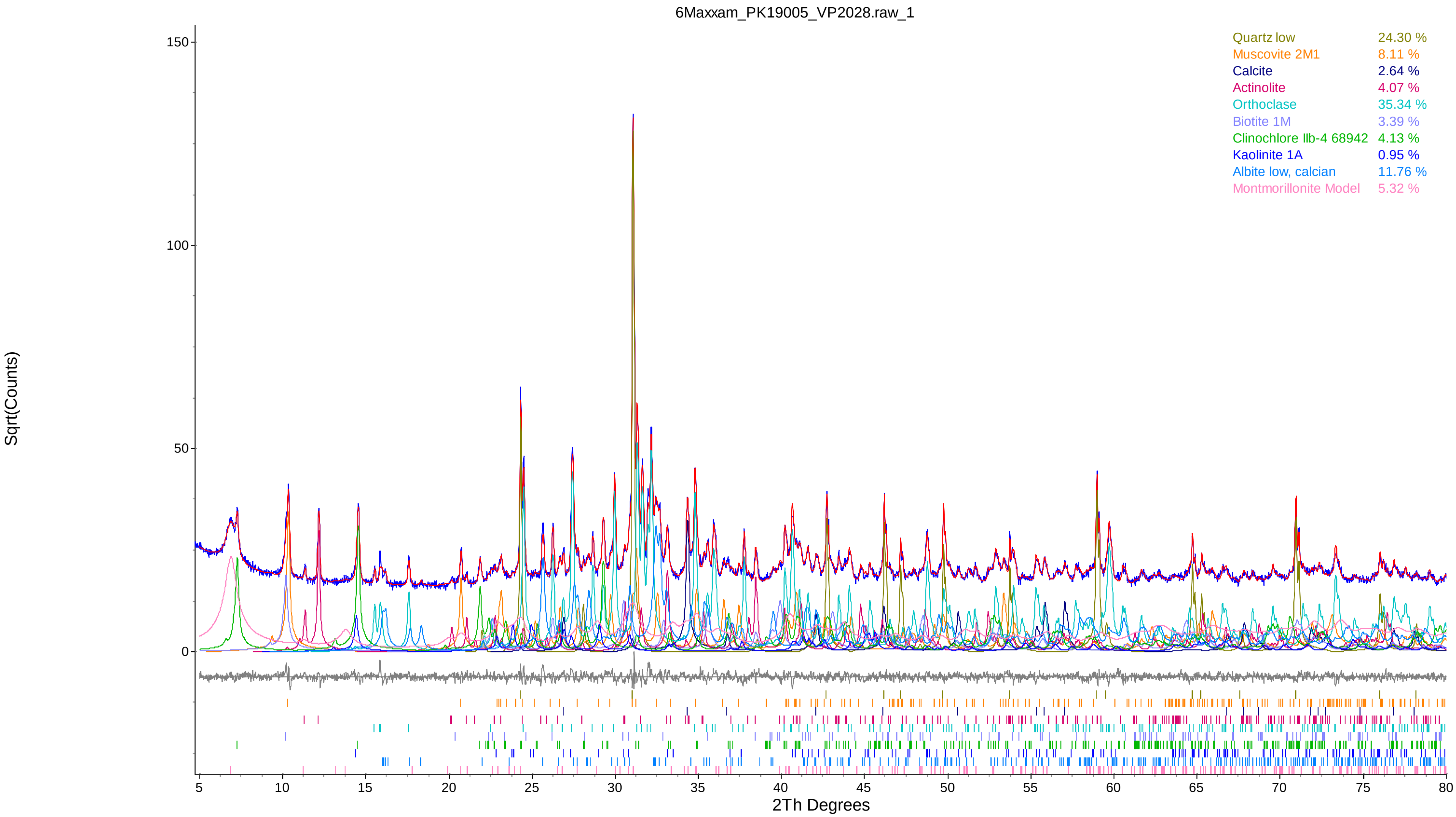

Figure 6. Rietveld refinement plot of sample **Maxxam Analytics 6_PK19005_VP2028** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

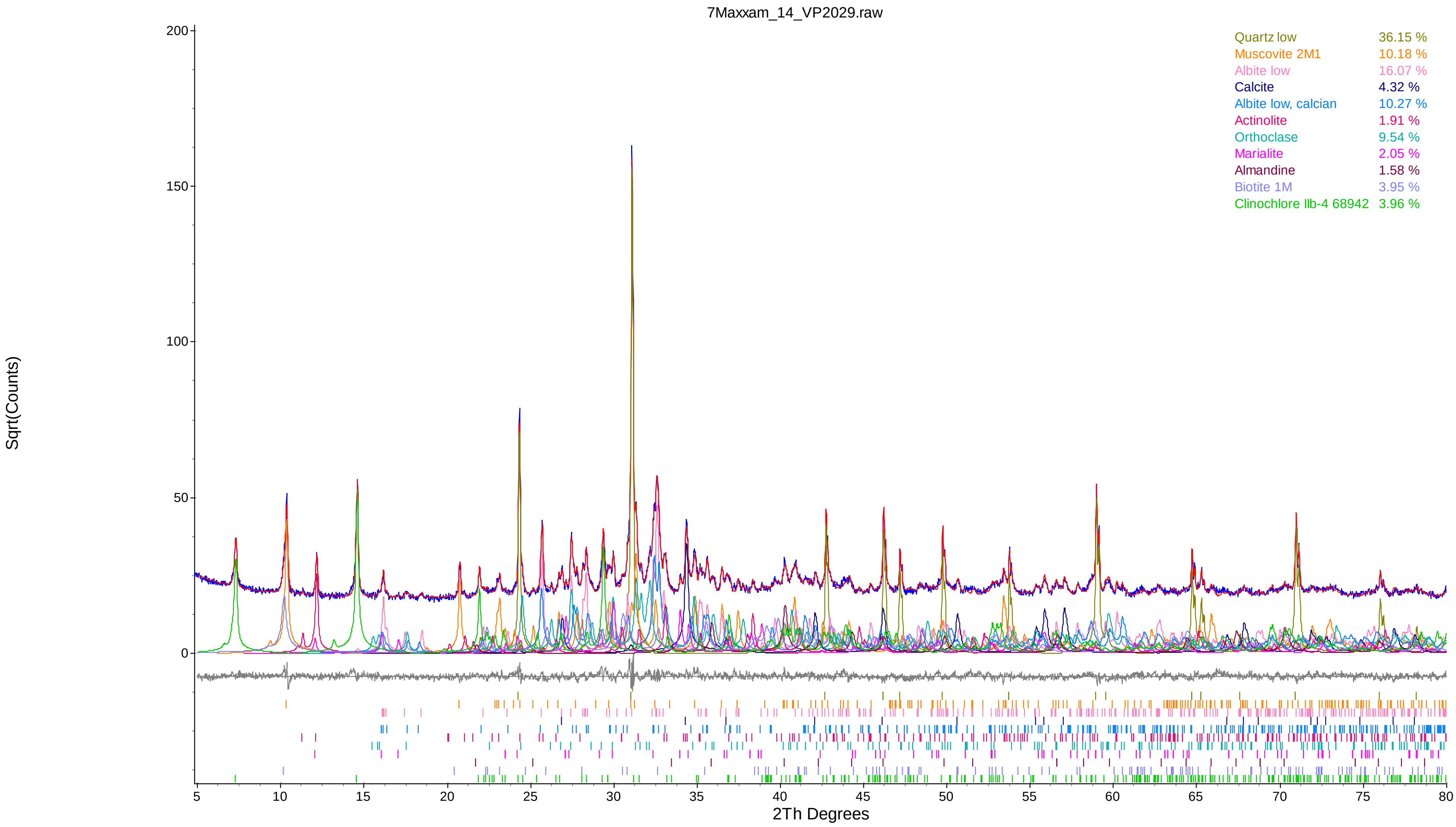

Figure 7. Rietveld refinement plot of sample **Maxxam Analytics 7_14_VP2029** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

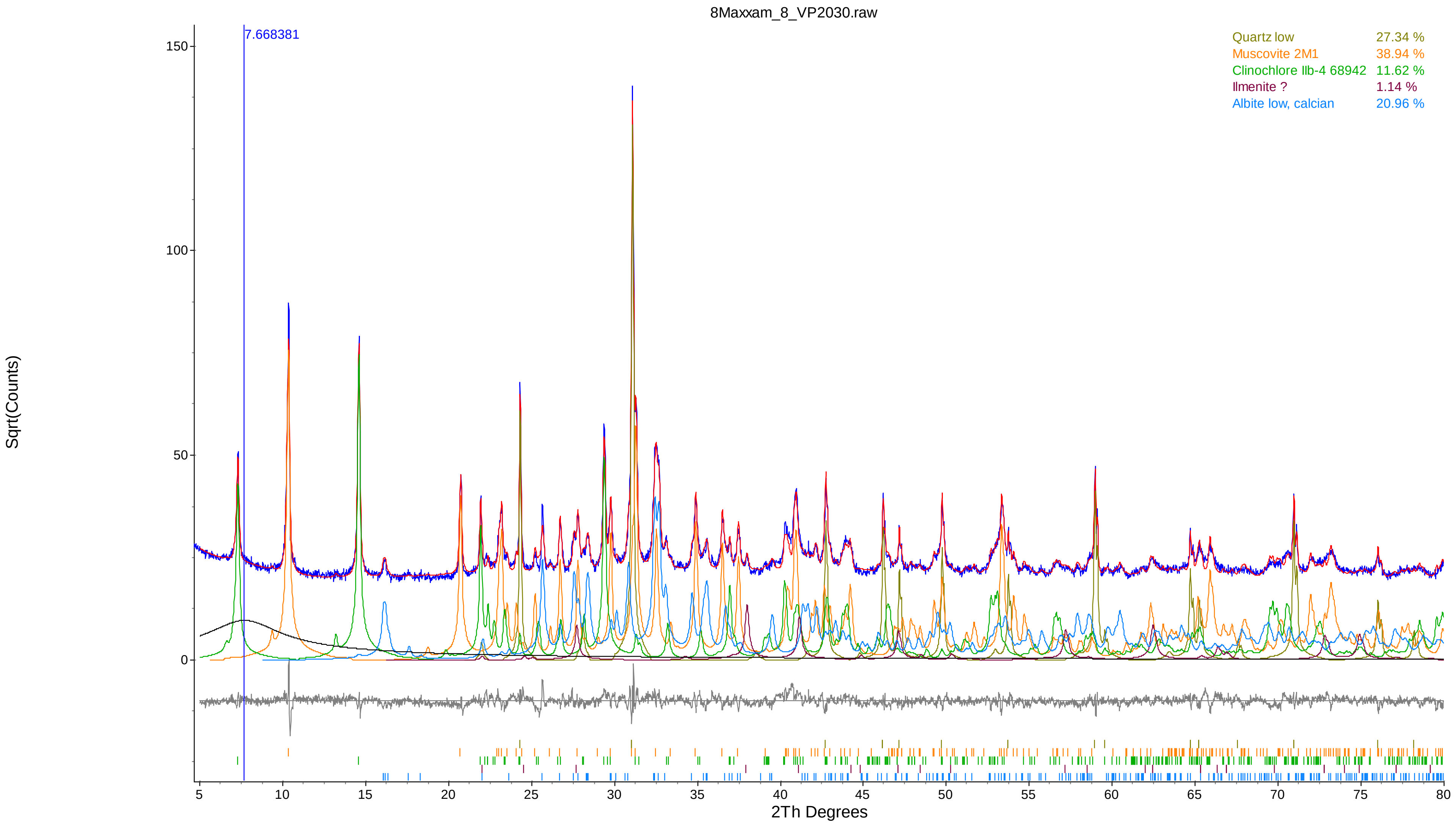

Figure 8. Rietveld refinement plot of sample **Maxxam Analytics 8_8_VP2030** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

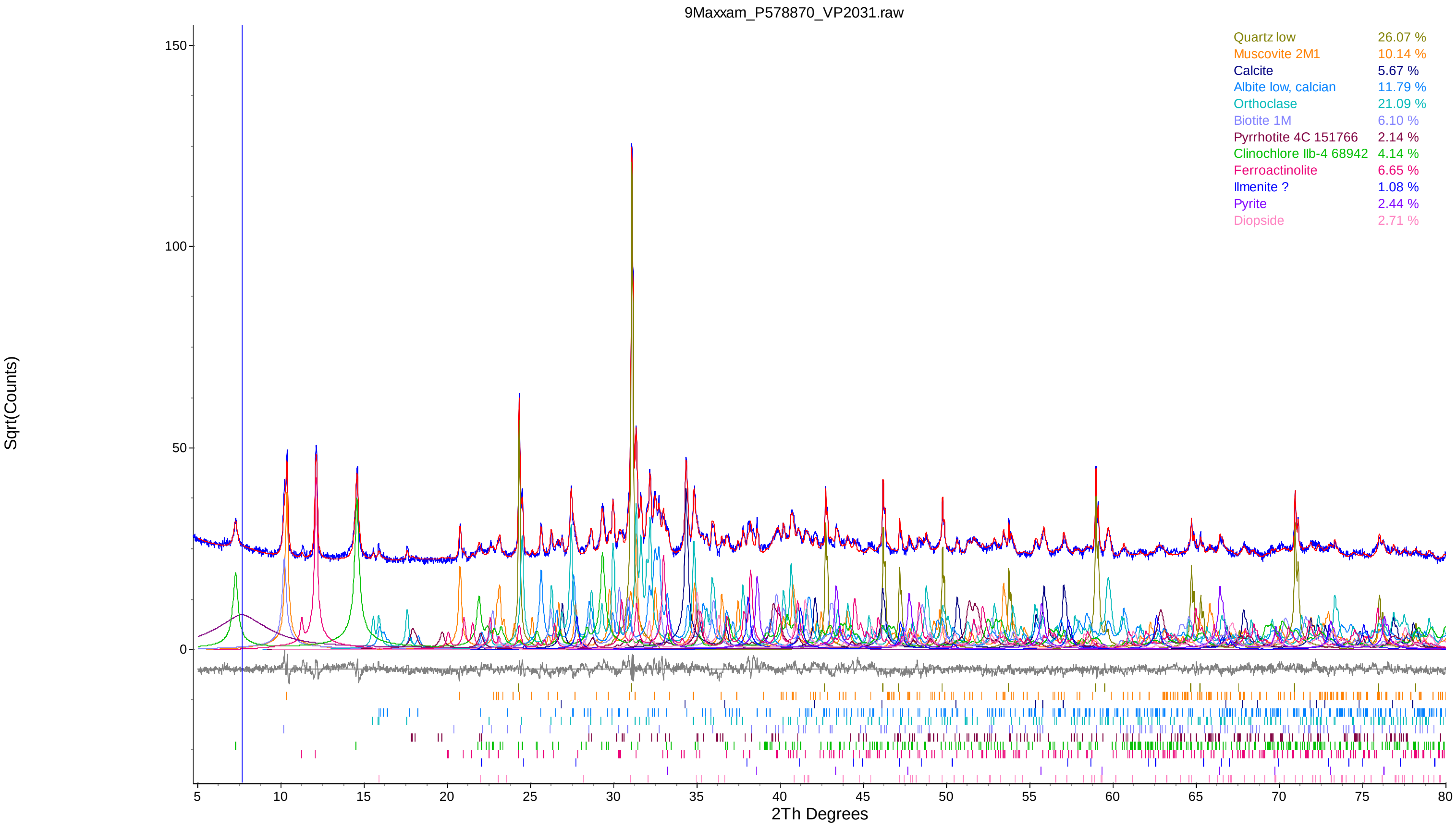

Figure 9. Rietveld refinement plot of sample **Maxxam Analytics 9_P578870_VP2031** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

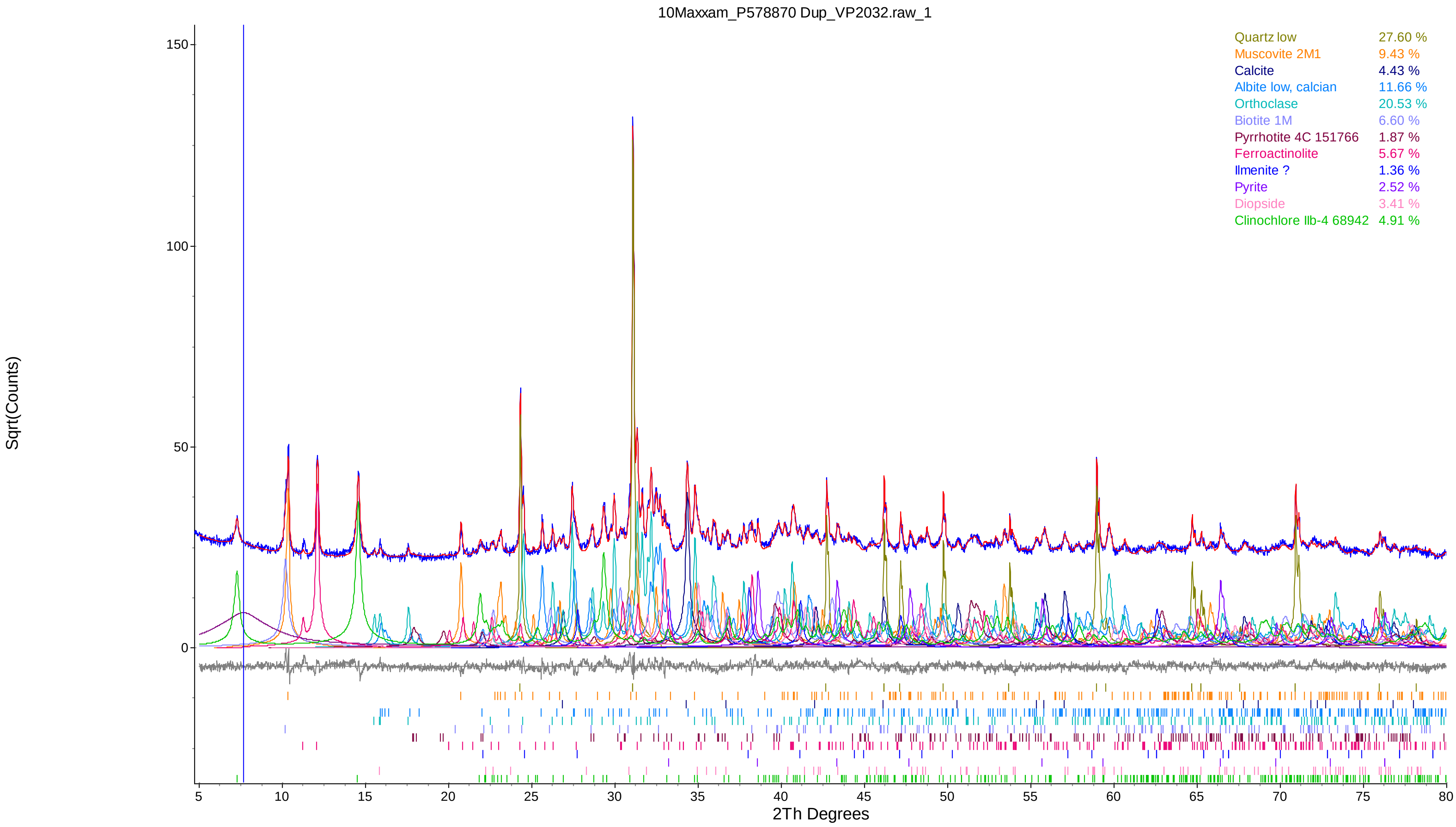

Figure 10. Rietveld refinement plot of sample **Maxxam Analytics 10_P578870 Dup_VP2032** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

Table 1. Results of quantitative phase analysis (wt.%) XRD-Rietveld Maxxam Analytical Project Royal Gold - Tetlin HCT B931765 - 10 samples

S.No.	**1**		**2**		**3**		**4**		**5**
Maxxam ID	**VP2023**		**VP2024**		**VP2025**		**VP2026**		**VP2027**
Client Sample ID	**18**		**PK19001**		**PK19002**		**P57884**		**PK19004**
Quartz	26.9	Quartz	49.2	Quartz	46.7	Quartz	52.9	Quartz	42.5
Calcite	1.7	Actinolite	1.3	Calcite	3.0	Muscovite 2M1	19.6	Muscovite 2M1	20.2
Orthoclase	18.2	Muscovite 2M1	8.9	Plagioclase	11.4	Clinochlore	4.2	Clinochlore	3.3
Muscovite 2M1	13.3	Calcite	6.0	Pyrrhotite	1.9	Plagioclase	14.8	Plagioclase	14.8
Biotite	6.3	Pyrite	2.0	Actinolite	2.2	Calcite	1.8	Orthoclase	9.8
Plagioclase	20.0	Plagioclase	3.8	Orthoclase	17.7	Actinolite	1.0	Calcite	0.8
Pyrite	1.8	Kaolinite 1A	3.4	Muscovite 2M1	4.2	Orthoclase	3.0	Biotite	3.4
Clinochlore	3.8	Clinochlore	3.9	Titanite	6.9	Biotite	2.3	Marialite	1.1
Ilmenite	1.0	Orthoclase	21.2	Dolomite	0.9	Ilmenite	0.3	Titanite	1.2
Ferroactinolite	7.1	Hematite ?	0.2	Marcasite ?	0.4			Actinolite	2.7
				Clinochlore	4.7			Gypsum	0.3
Total	**100.0**		**100.0**		**100.0**		**100.0**		**100.0**

S.No.	**6**		**7**		**8**		**9**		**10**
Maxxam ID	**VP2028**		**VP2029**		**VP2030**		**VP2031**		**VP2032**
Client Sample ID	**PK19005**		**14**		**8**		**P578870**		**P578870 Dup**
Quartz	24.3	Quartz	36.2	Quartz	27.3	Quartz	26.1	Quartz	27.6
Muscovite 2M1	8.1	Muscovite 2M1	10.2	Muscovite 2M1	38.9	Muscovite 2M1	10.1	Muscovite 2M1	9.4
Calcite	2.6	Plagioclase	26.3	Clinochlore	11.6	Calcite	5.7	Calcite	4.4
Actinolite	4.1	Calcite	4.3	Ilmenite ?	1.1	Plagioclase	11.8	Plagioclase	11.7
Orthoclase	35.3	Actinolite	1.9	Plagioclase	21.0	Orthoclase	21.1	Orthoclase	20.5
Biotite	3.4	Orthoclase	9.5			Biotite	6.1	Biotite	6.6
Clinochlore	4.1	Marialite	2.1			Pyrrhotite	2.1	Pyrrhotite	1.9
Kaolinite 1A	1.0	Almandine	1.6			Clinochlore	4.1	Ferroactinolite	5.7
Plagioclase	11.8	Biotite	4.0			Ferroactinolite	6.6	Ilmenite ?	1.4
Montmorillonite Model	5.3	Clinochlore	4.0			Ilmenite ?	1.1	Pyrite	2.5
						Pyrite	2.4	Diopside	3.4
						Diopside	2.7	Clinochlore	4.9
Total	**100.0**		**100.0**		**100.0**		**100.0**		**100.0**

Appendix A2: Mineralogy Reports Waste Rock (2021)

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August 3, 2021

Tim O'Hearn, M.Eng., P.Eng.
Analyst, Acid Rock Drainage
Bureau Veritas Laboratories
4606 Canada Way,
Burnaby, BC Canada V5G 1K5

CC: Vivian Ferrera, Jason Wai, Bonnie Tsang

Re: Mineralogical Assessment of the Seven Test Samples
Proposal No. PME2105905 – Manh Choh Project of Peak Gold LLC.

Dear Mr. O'Hearn,

We have completed the mineralogical assessment on the seven test samples that you provided. The sample list is shown in the Table below. These seven test samples were generated from the ARD tests (C129658) at BV Labs in Burnaby for the SRK Consulting – Manh Choh Project of Peak Gold LLC.

SAMPLE RECEIVING LOG SHEET

Count	Sample ID	Client Sample ID
1	ZS8665	3462106+3462107 COMPOSITE
2	ZS8666	3357767
3	ZS8667	3357784
4	ZS8668	3357772
5	ZS8669	3462022
6	ZS8670	3461388
7	ZS8671	3461315

The principal objective of this study was to identify and quantify mineral abundances of the provided seven test samples. To achieve the program, the QEMSCAN Bulk Mineral Analysis (BMA) was conducted on each of the unsized samples as received.

The data, in terms of the chemical and mineral compositions of the seven test samples, together with the sulphur deportments by sulphur bearing minerals, are summarized in Table 1 to 2 and Figure 1 on the following pages of this letter. All the information produced by this study are shown in three appendices attached at the end of this letter:

Appendix I – Sample Origin and Methodology
Appendix II – QEMSCAN Bulk Mineral Analysis (BMA)
Appendix III – X-Ray Diffraction Analysis

Thank you for inviting BV Minerals – Metallurgical Division to participate in this mineralogical testing program. If you have any questions regarding this study or our assessment of the data, please do not hesitate to contact us.

Kind regards,

Wendy Ma, M.Sc. P. Geo.
Mineralogy Manager

TABLE 1
CHEMICAL COMPOSITION OF THE SEVEN TEST SAMPLES

Element	Symbol	ZS8665	ZS8666	ZS8667	ZS8668	ZS8669	ZS8670	ZS8671
		3462106+ 3462107 Composite	3357767	3357784	3357772	3462022	3461388	3461315
Aluminum	Al	7.35	5.36	6.67	7.44	6.85	8.15	5.35
Carbon	C	0.02	0.06	0.02	0.02	0.05	1.06	0.51
Calcium	Ca	0.02	0.06	0.02	0.02	0.05	1.06	0.51
Iron	Fe	5.68	16.4	3.76	4.78	5.93	6.97	15.9
Potassium	K	4.29	1.93	3.15	4.13	2.71	3.61	3.52
Magnesium	Mg	1.04	1.21	0.68	0.49	0.84	1.01	0.83
Silicon	Si	28.9	24.3	32.7	31.0	31.6	26.4	23.6
Sulphur	S	0.02	0.02	0.02	0.02	0.07	0.09	6.98
Titanium	Ti	0.37	0.24	0.29	0.41	0.35	0.37	0.31

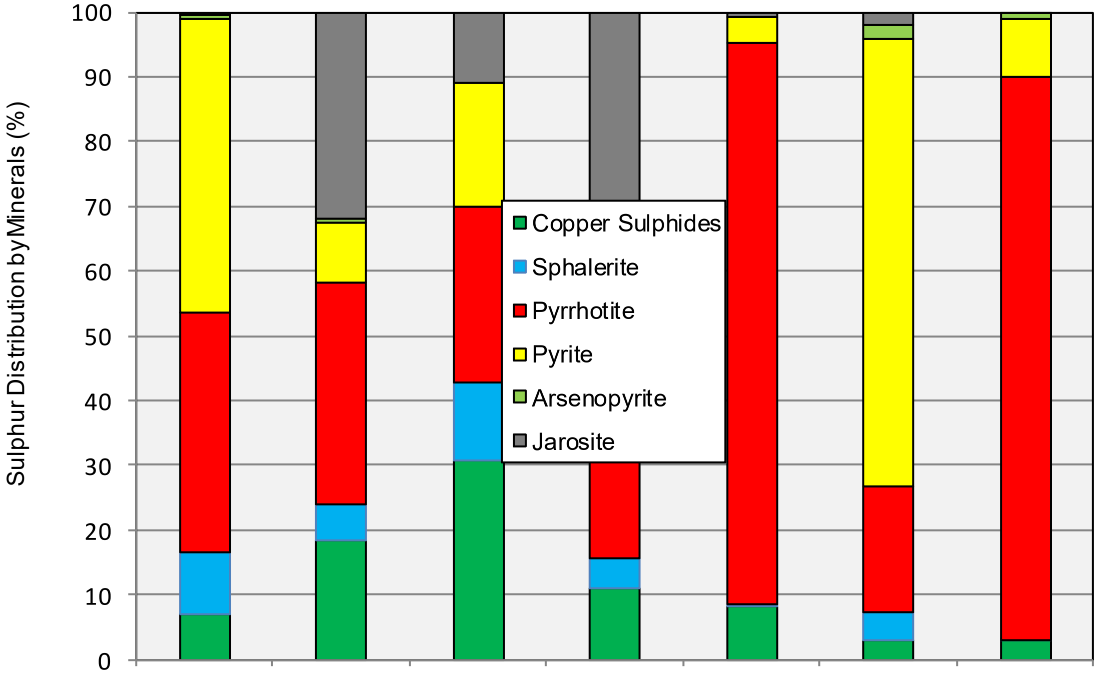
Note: 1) All elements were measured in percent.

TABLE 2
MINERAL COMPOSITION OF THE SEVEN TEST SAMPLES

Minerals (wt. %)	ZS8665	ZS8666	ZS8667	ZS8668	ZS8669	ZS8670	ZS8671
	3462106+ 3462107 Composite	3357767	3357784	3357772	3462022	3461388	3461315
Copper Sulphides	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.61
Sphalerite	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrrhotite	<0.1	<0.1	<0.1	<0.1	0.27	0.03	14.01
Pyrite	<0.1	<0.1	<0.1	<0.1	<0.1	0.11	1.18
Arsenopyrite	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.38
Sulphide Total	**0.01**	**0.03**	**0.03**	**0.03**	**0.31**	**0.19**	**16.2**
Iron Oxides	1.67	18.3	0.86	2.09	2.26	3.38	1.35
Quartz	27.0	28.0	38.1	32.3	45.0	36.0	26.7
K-Feldspars	27.3	7.00	18.7	25.0	8.38	6.87	24.1
Plagioclase Feldspar	6.29	4.06	16.4	3.15	7.21	3.75	5.03
Muscovite	18.9	13.1	10.2	23.1	22.8	30.7	7.06
Chlorite	9.55	22.9	6.51	8.31	11.0	9.82	7.61
Amphibole (Actinolite)	0.81	1.73	2.35	0.15	0.26	0.41	2.68
'Kaolinite' (clay)	3.60	0.55	2.44	4.34	0.63	0.73	0.17
Biotite/Phlogopite	3.14	2.62	2.00	1.11	1.12	0.93	1.65
Calcite	0.03	0.02	0.00	0.01	0.01	6.57	2.64
Epidote	0.50	0.49	0.99	0.03	0.07	0.13	2.56
Ti Minerals	0.96	0.31	1.04	0.28	0.75	0.22	1.09
Apatite	0.15	0.42	0.22	0.03	0.17	0.05	0.12
Others	0.11	0.46	0.16	0.10	0.09	0.29	0.98
Non-Sulphide Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note: 1) Copper Sulphides include Covellite and Enargite/Tennantite.
2) Iron Oxides include Geothite, Magnetite, Hematite, Jarosite and Iron Metal.
3) Ti Minerals include Rutile/Anatase, Sphene and Ilmenite.
4) Others include trace amount of Apatite, Ce-phosphate (Monazite), Barite, and unresolved mineral species.

FIGURE 1
SULPHUR DEPORTMENT BY THE SULPHUR BEARING MINERAL SPECIES



MINERALOGICAL ASSESSMENTS OF SEVEN TEST SAMPLES

APPENDIX I

SAMPLE ORIGIN AND METHDOLOGY

AUGUST 3, 2021

1. Sample Origin and Methodology:

Seven test samples were received for the mineralogical assessment on July 16, 2021 at the BV-Metallurgical Division in Canada. These seven test samples were generated from the ARD tests (C129658) at BV Labs in Burnaby for the SRK Consulting – Manh Choh Project of Peak Gold LLC. The sample list is shown in the Table below.

SAMPLE RECEIVING LOG SHEET

Count	Sample ID	Client Sample ID
1	ZS8665	3462106+3462107 COMPOSITE
2	ZS8666	3357767
3	ZS8667	3357784
4	ZS8668	3357772
5	ZS8669	3462022
6	ZS8670	3461388
7	ZS8671	3461315

.

Upon receipt of the samples, each of the unsized samples as received was mounted into the 30mm blocks using epoxy. During the mounting, graphite was added into each sample block in order to decrease the particle touching and the settlement of mineral particles with relatively high specific gravity. The mounted sample blocks were ground, polished and carbon coated following the standard QEMSCAN sample preparation procedures.

Following the sample preparations, the QEMSCAN Bulk Mineral Analysis (BMA) was then performed on the each of the seven test samples. The SIP (Specific Identification Protocols) was particularly developed to determine the mineral compositions of these seven test samples. The data, generated from the QEMSCAN Bulk Mineral Analysis (BMA), can be located in Appendix II. The X-Ray Diffraction (XRD) analysis was also performed on each of the seven test samples to assist the QEMSCAN calibrations for non-sulphide minerals. The XRD data can be located in Appendix III.

MINERALOGICAL ASSESSMENTS OF THE SEVEN TEST SAMPLES

APPENDIX II

BULK MINERAL ANALYSIS (BMA) DATA

AUGUST 3, 2021

TABLE 1
MINERAL COMPOSITION OF THE SEVEN TEST SAMPLES
ME2104807

BV Sample ID	ZS8665	ZS8666	ZS8667	ZS8668	ZS8669	ZS8670	ZS8671
Client Sample ID	3462106+3462107 COMPOSITE	3357767	3357784	3357772	3462022	3461388	3461315
Acanth/Argentite	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chalcopyrite	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.6
Covellite	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Enargite/Tennantite	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Cu-Metal/Cuprite	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Sphalerite	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrrhotite	<0.1	<0.1	<0.1	<0.1	0.3	<0.1	14.0
Pyrite	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	1.2
Arsenopyrite	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.4
Arseniosiderite	<0.1	0.3	<0.1	<0.1	<0.1	<0.1	<0.1
Jarosite	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Iron Oxides	1.7	18.3	0.8	2.0	2.3	3.4	1.3
Quartz	27.0	28.0	38.1	32.3	45.0	36.0	26.7
K-Feldspars	27.3	7.0	18.7	25.0	8.4	6.9	24.1
Plagioclase Feldspar	6.3	4.1	16.4	3.1	7.2	3.7	5.0
Muscovite	18.9	13.1	10.2	23.1	22.8	30.7	7.1
Chlorite	9.5	22.9	6.5	8.3	11.0	9.8	7.6
Amphibole (Actinolite)	0.8	1.7	2.4	0.2	0.3	0.4	2.7
'Kaolinite' (clay)	3.6	0.6	2.4	4.3	0.6	0.7	0.2
Biotite/Phlogopite	3.1	2.6	2.0	1.1	1.1	0.9	1.6
Calcite	<0.1	<0.1	<0.1	<0.1	<0.1	6.6	2.6
Epidote	0.5	0.5	1.0	<0.1	0.1	0.1	2.6
Ti Minerals	1.0	0.3	1.0	0.3	0.7	0.2	1.1
Apatite	0.2	0.4	0.2	<0.1	0.2	0.1	0.1
Zircon	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Others	<0.1	0.1	0.1	0.1	0.1	0.3	0.9
Total	100	100	100	100	100	100	100

Note: 1) Iron Oxides includes Geothite, Hematite, Magnetite, Steel/Pure Iron.
2) Ti Minerals include Rutile/Anatase, Sphene and Ilmenite.
3) Zircon includes Ce-phosphate (Monazite).
4) Others includes trace amounts of Barite, Cassiterite, Spinel, Corundum/Diaspore and unresolved mineral species.

TABLE 2
SULPHUR DEPORTMENT BY THE SULPHUR BEARING MINERALS

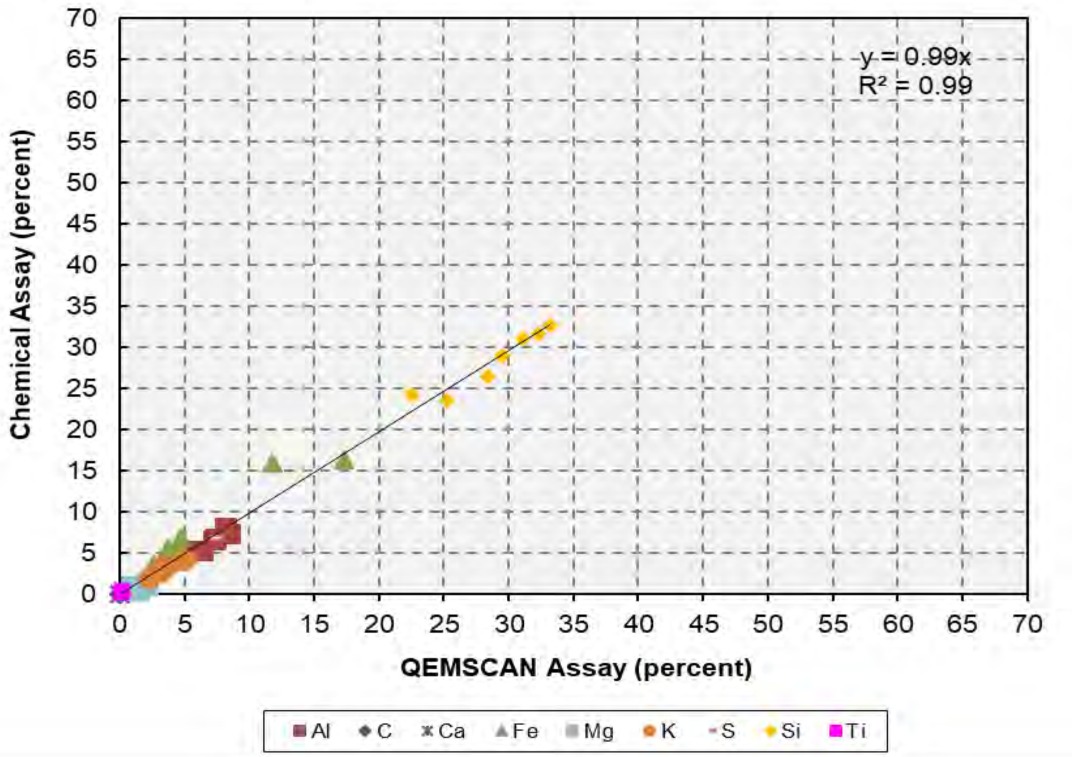
Minerals	% Sulphur of Total Sulphur						
	ZS8665	ZS8666	ZS8667	ZS8668	ZS8669	ZS8670	ZS8671
Copper Sulphides	7.1	18.6	30.7	11.0	8.4	3.0	3.0
Sphalerite	9.6	5.4	12.0	4.5	0.2	4.2	0.1
Pyrrhotite	37.0	34.2	27.1	22.3	86.6	19.5	86.9
Pyrite	45.1	9.4	19.3	27.7	4.0	69.1	9.0
Arsenopyrite	0.7	0.7	0.0	0.9	0.0	2.2	1.1
Jarosite	0.5	31.8	10.9	33.5	0.8	1.9	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note: 1) Jarosite includes Braite.

TABLE 3
ASSAY RESULTS AND RECONCILIATION
ME2104807

Element	Assay Methods	ZS8665	ZS8666	ZS8667	ZS8668	ZS8669	ZS8670	ZS8671
Al	QEMSCAN	8.28	6.32	7.23	8.46	7.38	8.19	5.85
	Chemical	7.35	5.36	6.67	7.44	6.85	8.15	5.35
C	QEMSCAN	0.02	0.07	0.01	0.01	0.02	0.80	0.36
	Chemical	0.02	0.06	0.02	0.02	0.05	1.06	0.51
Ca	QEMSCAN	0.02	0.07	0.01	0.01	0.02	0.80	0.36
	Chemical	0.02	0.06	0.02	0.02	0.05	1.06	0.51
Fe	QEMSCAN	3.78	17.3	2.65	3.97	4.40	4.78	11.8
	Chemical	5.68	16.4	3.76	4.78	5.93	6.97	15.9
K	QEMSCAN	5.00	2.19	3.16	4.95	3.18	3.76	3.33
	Chemical	4.29	1.93	3.15	4.13	2.71	3.61	3.52
Mg	QEMSCAN	2.04	2.09	0.91	1.44	1.25	1.20	0.90
	Chemical	1.04	1.21	0.68	0.49	0.84	1.01	0.83
S	QEMSCAN	0.00	0.01	0.01	0.02	0.12	0.09	7.03
	Chemical	0.02	0.02	0.02	0.02	0.07	0.09	6.98
Si	QEMSCAN	29.5	22.6	33.2	31.1	32.3	28.4	25.2
	Chemical	28.9	24.3	32.7	31.0	31.6	26.4	23.6
Ti	QEMSCAN	0.19	0.13	0.22	0.22	0.27	0.13	0.21
	Chemical	0.37	0.24	0.29	0.41	0.35	0.37	0.31

FIGURE 1
ASSAY RESULTS AND RECONCILIATION
ME2104807



MINERALOGICAL ASSESSMENTS OF THE SEVEN TEST SAMPLES

APPENDIX III

X-RAY DIFFRACTION ANALYSIS DATA

AUGUST 3, 2021

Table 1. Results of quantitative phase analysis (wt.%)*, Project: SRK Consulting - Manh Choh C129658

*results approximate due to use of montmorillonite model and presence of unanalyzed unknown clays

UBC & BVL No.		**1**		**2**		**3**
BVL Sample ID		**ZS8665**		**ZS8666**		**ZS8667**
Client Sample ID		**3462106+3462107 Composite**		**3357767**		**3357784**
	Quartz	30.7	Quartz	37.8	Quartz	39.9
	K-feldspar	32.7	K-feldspar	10.3	Plagioclase	16.7
	Illite/Muscovite 2M1	10.0	Goethite	12.7	K-feldspar	22.4
	Kaolinite	2.8	Clinochlore	2.7	Clinochlore	3.6
	Plagioclase	2.5	Biotite	2.8	Illite/Muscovite 2M1	9.5
	Montmorillonite Model	21.4	Plagioclase	3.6	Ferroactinolite	3.1
			Ferroactinolite	3.0	Kaolinite	2.2
			Kaolinite ?	2.2	Biotite	2.6
			Illite/Muscovite 2M1	9.7		
			Montmorillonite Model	15.2		
Total		100.0		100.0		100.0

UBC & BVL No.		**4**		**5**		**6**
BVL Sample ID		**ZS8668**		**ZS8669**		**ZS8670**
Client Sample ID		**3357772**		**3462022**		**3461388**
	Quartz	42.8	Quartz	50.0	Quartz	36.7
	K-feldspar	27.6	Plagioclase	8.8	Plagioclase	4.3
	Illite/Muscovite 2M1	17.1	K-feldspar	11.1	K-feldspar	6.8
	Kaolinite	5.1	Illite/Muscovite 2M1	21.1	Illite/Muscovite 2M1	30.3
	Anatase	0.4	Clinochlore	5.8	Clinochlore	7.5
	Plagioclase	4.2	Biotite	1.6	Calcite	9.7
	Biotite	2.7	Goethite	1.7	Goethite	3.2
					Kaolinite	1.4
		100.0		100.0		100.0

UBC & BVL No.		**7**
BVL Sample ID		**ZS8671**
Client Sample ID		**3461315**
	Quartz	22.2
	K-feldspar	27.4
	Illite/Muscovite 2M1	4.0
	Biotite	3.7
	Calcite	4.1
	Pyrrhotite	17.3
	Plagioclase	7.8
	Ferroactinolite	5.5
	Pyrite	1.6
	Chamosite	5.4
	Marcasite ?	0.9
		100.0

QUANTITATIVE PHASE ANALYSIS OF SEVEN POWDER SAMPLES USING THE RIETVELD METHOD AND X-RAY POWDER DIFFRACTION DATA.

Project: SRK Consulting – Manh Choh
ARD Project#: C129658

Tim O'Hearn
Bureau Veritas Laboratories
4606 Canada Way
Burnaby, BC V5G 1K5

Jacob Kabel, B.Sc.
Edith Czech, M.Sc.
Jenny Lai, B.Sc.
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Dept. of Earth, Ocean & Atmospheric Sciences
The University of British Columbia
6339 Stores Road
Vancouver, BC V6T 1Z4

May 19, 2021

EXPERIMENTAL METHOD

The seven samples of **Project: SRK Consulting – Manh Choh C129658** were reduced to the optimum grain-size range for quantitative X-ray analysis (<10 μm) by grinding under ethanol in a vibratory McCrone XRD Mill (Retsch GmbH, Germany) for 10 minutes. Continuous-scan X-ray powder-diffraction data were collected over a range 3-80°2θ with CoKα radiation on a Bruker D8 Advance Bragg-Brentano diffractometer equipped with an Fe filter foil, 0.6 mm (0.3°) divergence slit, incident- and diffracted-beam Soller slits and a LynxEye-XE detector. The long fine-focus Co X-ray tube was operated at 35 kV and 40 mA, using a take-off angle of 6°.

RESULTS

The X-ray diffractograms were analyzed using the International Centre for Diffraction Database PDF-4 and Search-Match software by Bruker. X-ray powder-diffraction data of the samples were refined with Rietveld program Topas 4.2 (Bruker AXS). The results of quantitative phase analysis by Rietveld refinements are given in Table 1 (separate file, ***BV Labs Results May 19 2021 - Project SRK Consulting-Manh Choh C129658 - 7 samples.xlsx***). These amounts represent the relative amounts of crystalline phases normalized to 100%. The Rietveld refinement plots are shown in Figures 1 – 7. Ideal formulae of the mineral phases present are shown in Table 2.

The samples in Figures 1 and 2 contain swelling clay (smectite group), likely montmorillonite mixed with unknown clay(s). As the crystal structure of this mineral is disordered and not predictable, we have used an empirical model to fit the pattern and to estimate the amount. The samples in Figures 3 – 6 also contain a small, unanalyzed amount of unknown clays, fitted with calculated peaks phases (positions indicated by vertical blue lines in corresponding figures). The results should be considered approximate.

Table 2. Ideal formulae of phases present, Project: SRK Consulting – Manh Choh C129658

Mineral	**Ideal Formula**
Anatase	TiO_2
Biotite	$K(Mg,Fe^{2+})_3AlSi_3O_{10}(OH)_2$
Calcite	$CaCO_3$
Chamosite	$(Fe^{2+},Mg,Al)_6(Si,Al)_4O_{10}(OH)_8$
Clinochlore	$(Mg,Fe^{2+})_5Al(Si_3Al)O_{10}(OH)_8$
Ferro-actinolite	$Ca_2(Fe^{2+},Mg)_5Si_8O_{22}(OH)_2$
Goethite	$\alpha\text{-}Fe^{3+}O(OH)$
Illite-Muscovite 2M1	$K_{0.65}Al_{2.0}Al_{0.65}Si_{3.35}O_{10}(OH)_2\text{-}KAl_2AlSi_3O_{10}(OH)_2$
Kaolinite	$Al_2Si_2O_5(OH)_4$
K-feldspar (orthoclase)	$KAlSi_3O_8$
Marcasite	FeS_2
Montmorillonite (model)	$(Na,Ca)_{0.3}(Al,Mg)_2Si_4O_{10}(OH)_2{\cdot}nH_2O$
Plagioclase (albite, andesine)	$NaAlSi_3O_8 – CaAl_2Si_2O_8$
Pyrite	FeS_2
Pyrrhotite	$Fe_{1-x}S$
Quartz	SiO_2

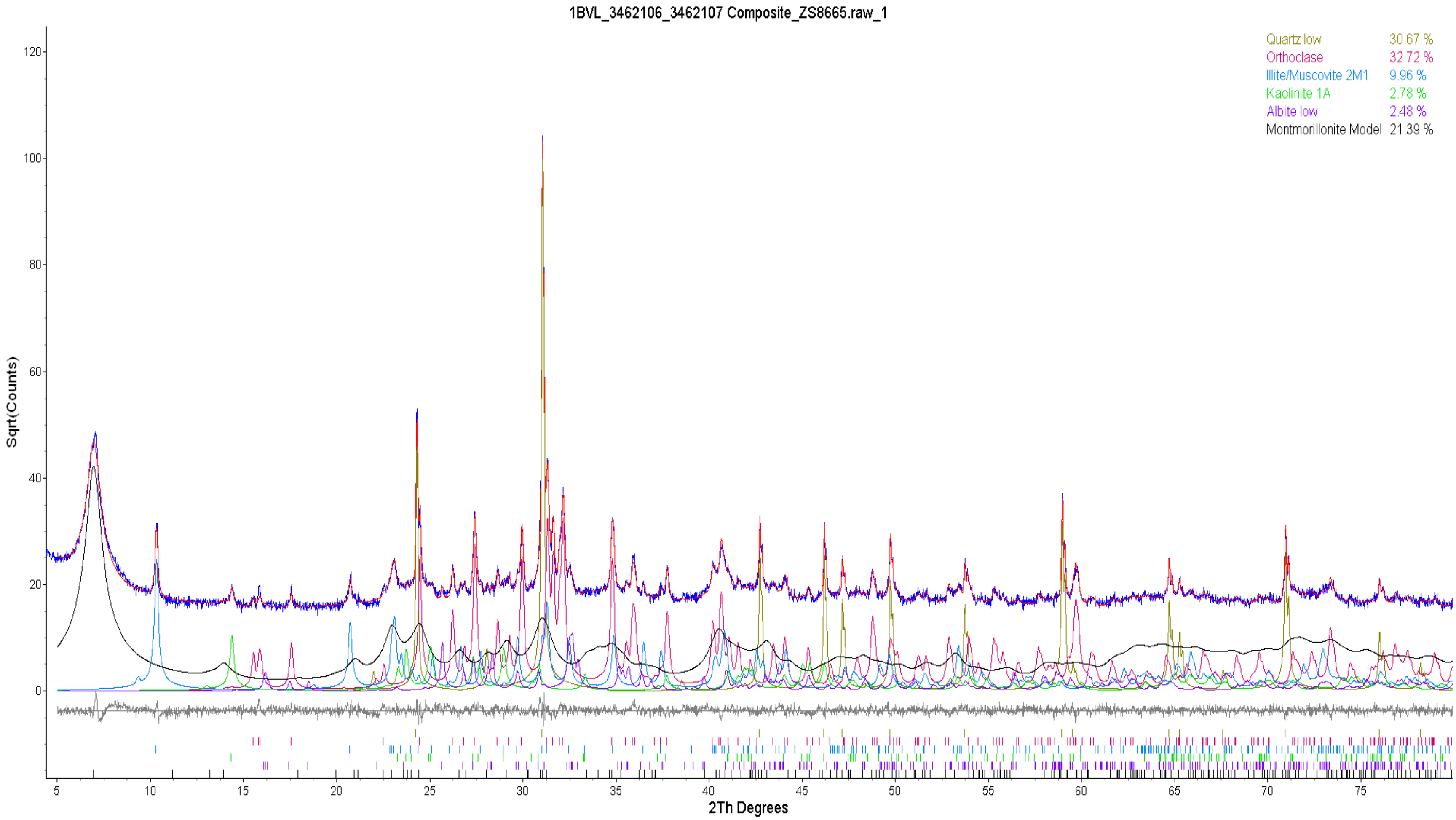

Figure 1. Rietveld refinement plot of sample **BV Labs – #1: 3462106+3462107 Composite (ZS8665)** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below - difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

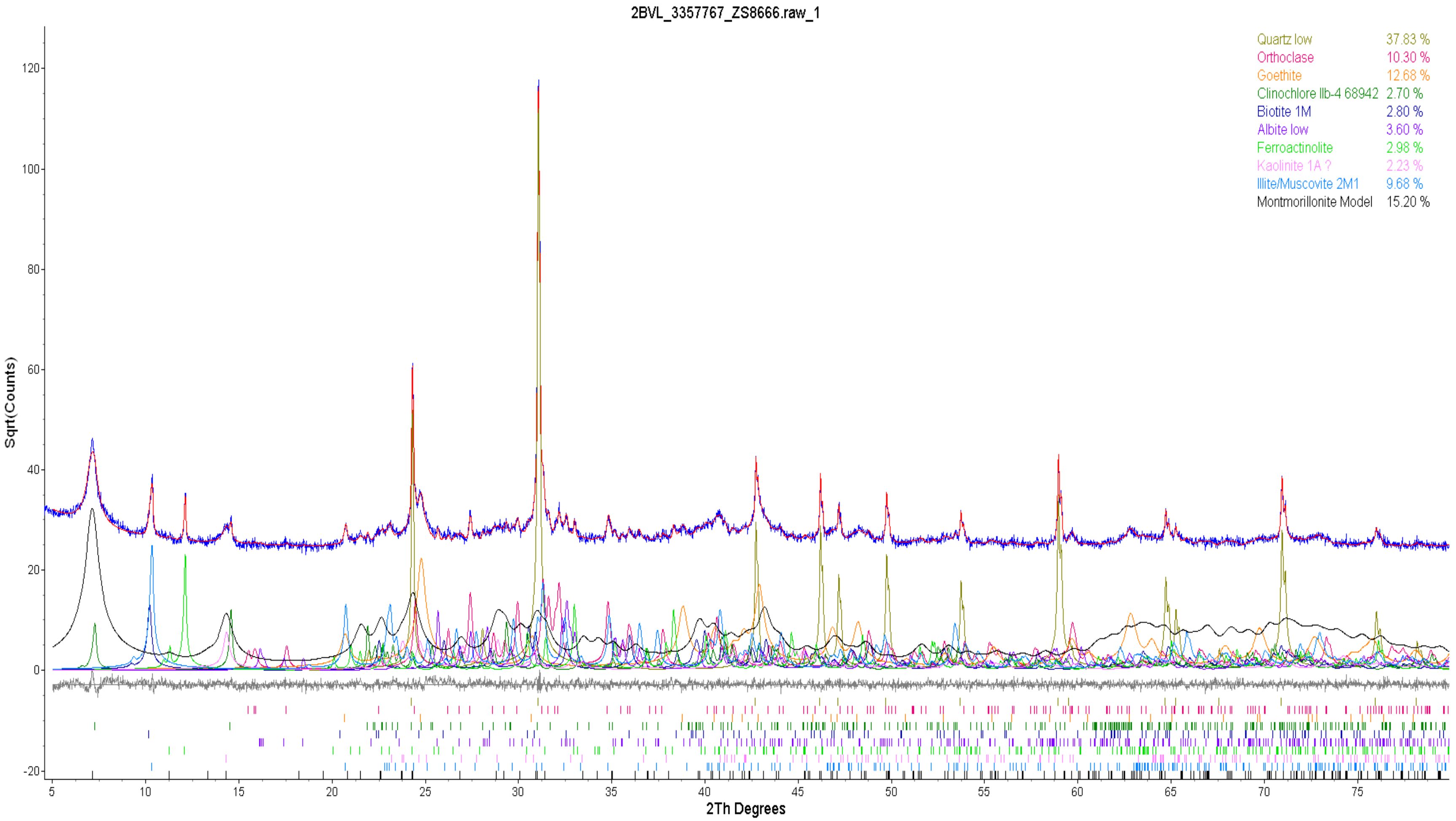

Figure 2. Rietveld refinement plot of sample **BV Labs – #2: 3357767 (ZS8666)** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below - difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

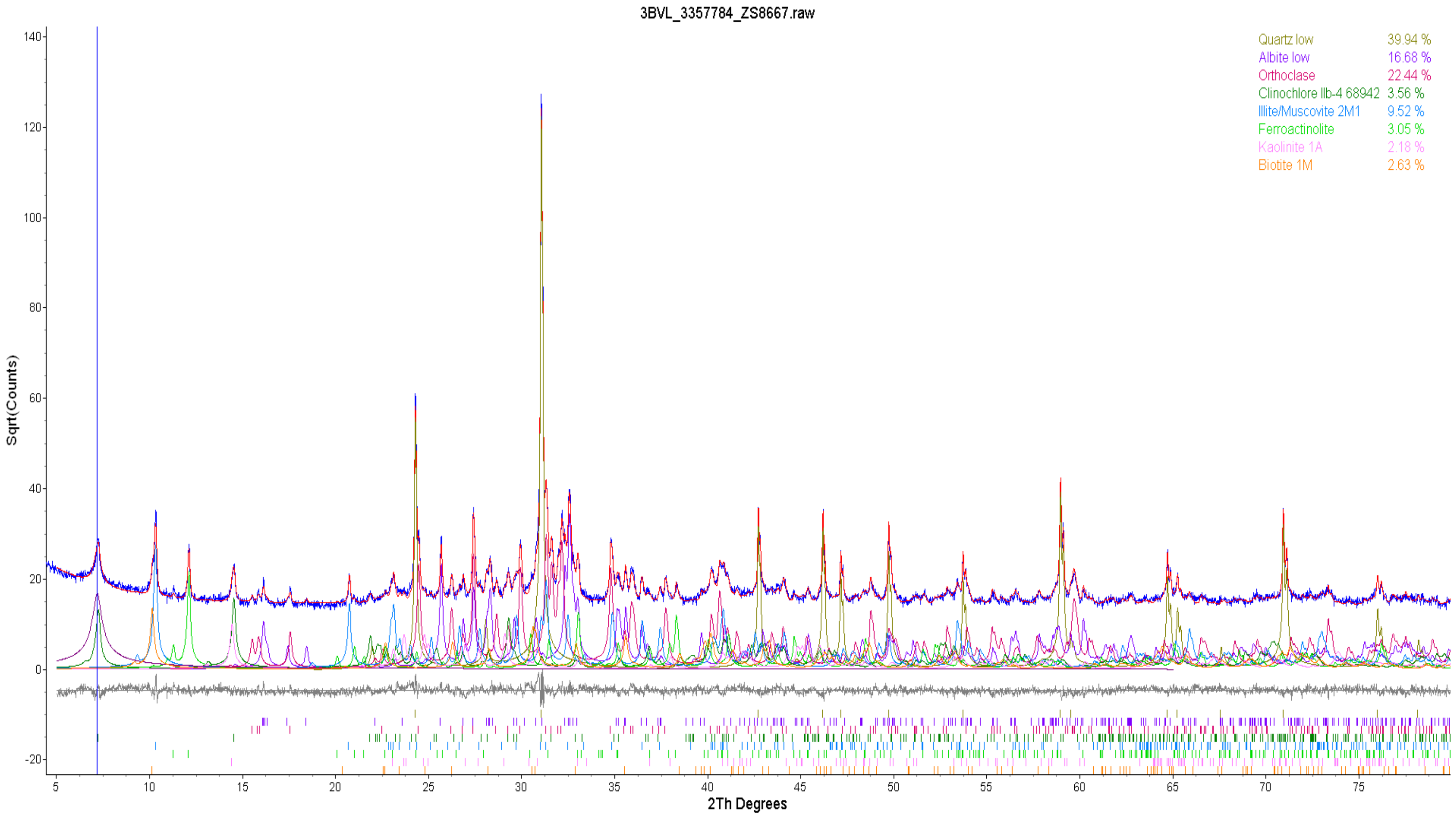

Figure 3. Rietveld refinement plot of sample **BV Labs – #3: 3357784 (ZS8667)** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below - difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections; vertical blue line - position of peaks phase). Coloured lines are individual diffraction patterns of all phases.

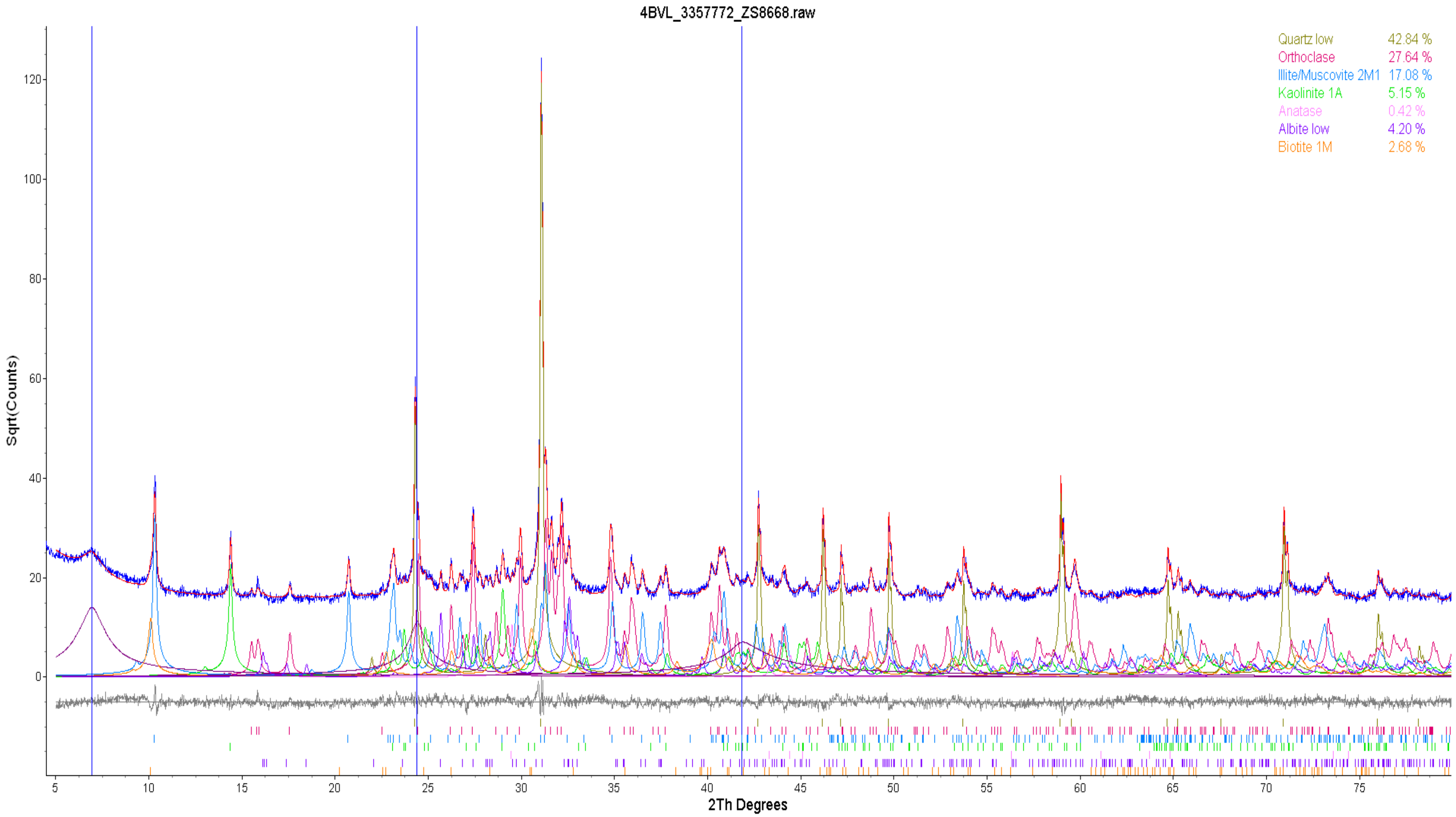

Figure 4. Rietveld refinement plot of sample **BV Labs – #4: 3357772 (ZS8668)** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below - difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections; vertical blue lines - positions of peaks phases). Coloured lines are individual diffraction patterns of all phases.

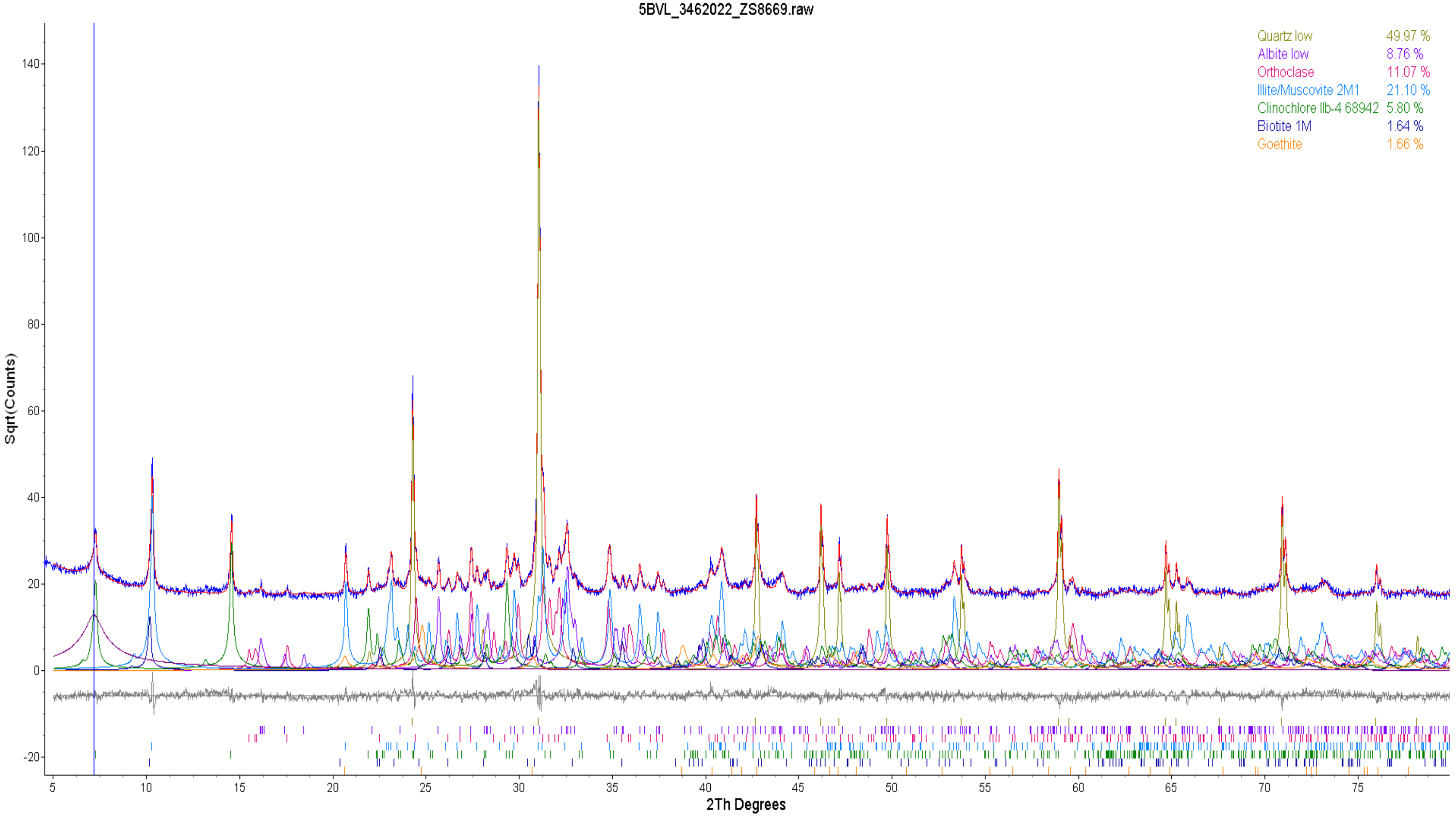

Figure 5. Rietveld refinement plot of sample **BV Labs – #5: 3462022 (ZS8669)** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below - difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections; vertical blue line - position of peaks phase). Coloured lines are individual diffraction patterns of all phases.

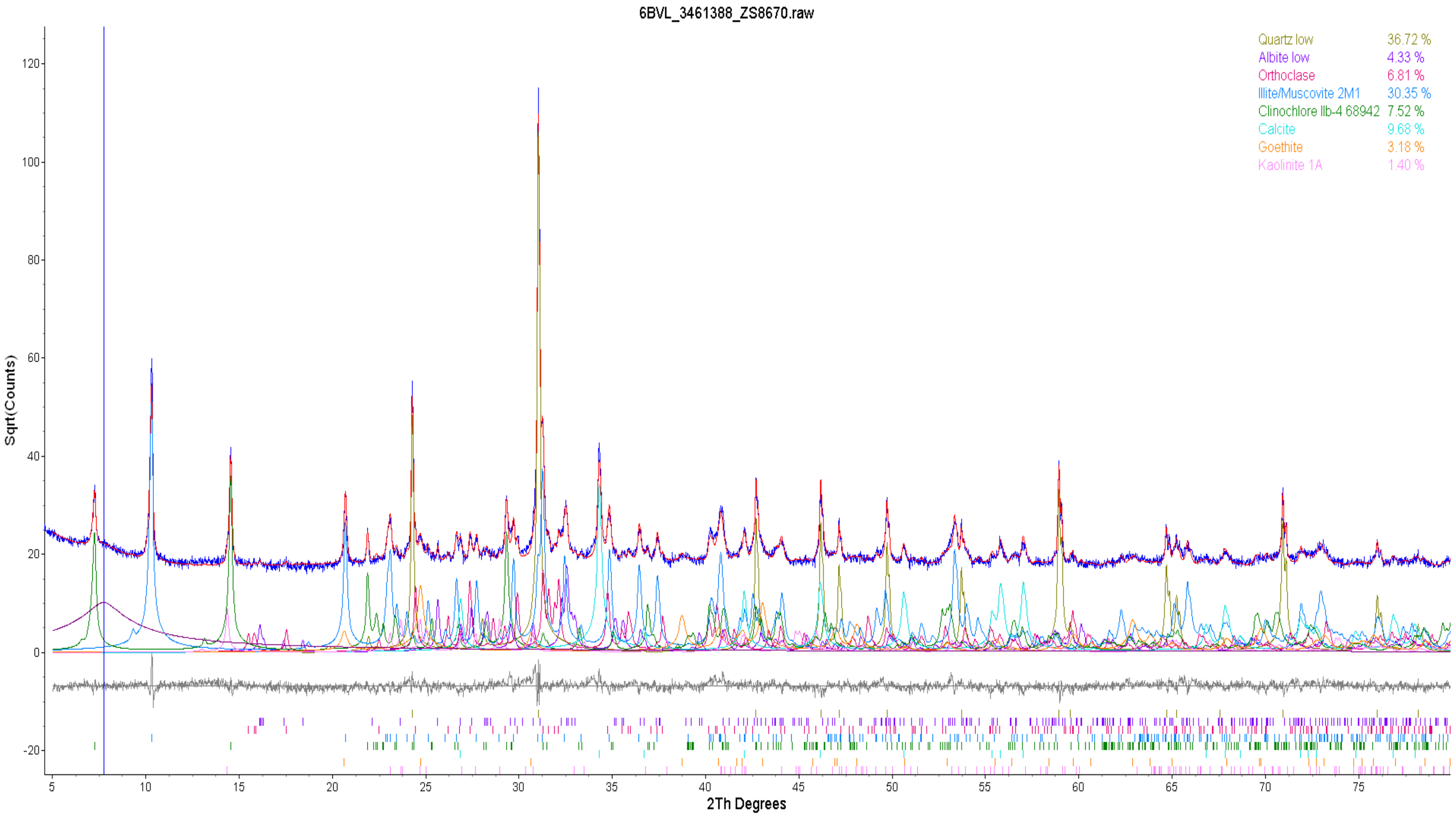

Figure 6. Rietveld refinement plot of sample **BV Labs – #6: 3461388 (ZS8670)** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below - difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections; vertical blue line - position of peaks phase). Coloured lines are individual diffraction patterns of all phases.

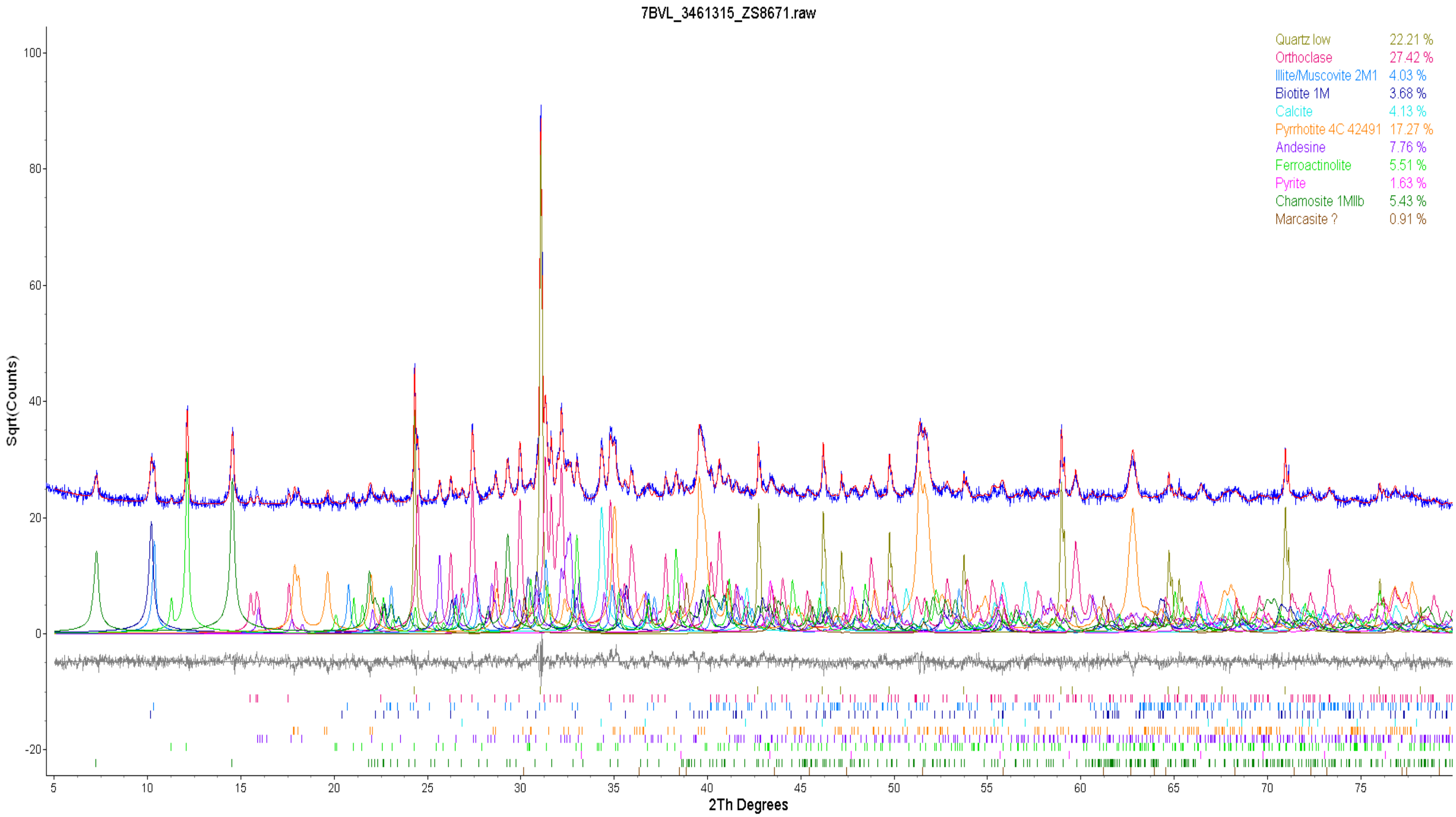

Figure 7. Rietveld refinement plot of sample **BV Labs – #7: 3461315 (ZS8671)** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below - difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

Appendix A3: Mineralogy Reports Ore Samples (2022)

BV Minerals - Metallurgical Division
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June 23, 2022

Tim O'Hearn, M.Eng., P.Eng.
Analyst, Acid Rock Drainage
Bureau Veritas Laboratories
4606 Canada Way,
Burnaby, BC Canada V5G 1K5

CC: Vivian Ferrera, Jason Wai, Bonnie Tsang, Jennifer Villocero

Re: Mineralogical Assessment of the Three Test Samples
Proposal No. PME2111711 – Peak Gold - Kinross - Manh Choh Project

Dear Mr. O'Hearn,

We have completed mineralogical assessment of the three test samples, labeled as AOB969-4646-01, AOB970-4646-02 and AOB971-4646-03. These three test samples were generated from the Acid Rock Drainage (ARD) tests (C207283) for the Peak Gold - Kinross - Manh Choh project at BV Labs in Burnaby. The principal objective of this study was to identify and quantify mineral abundances of the provided three test samples.

To achieve the program, the standard chemical analysis and QEMSCAN Bulk Mineral Analysis (BMA) protocols were conducted on each of the unsized three test samples as received to identify and quantify the chemical and mineral compositions of these three test samples. The Quantitative X-Ray Diffraction (QXRD) analysis was also performed on each of these three test samples to assist the QEMSCAN BMA calibrations for non-sulphide gangue.

The data generated from this study, in terms of the chemical and mineral compositions of the three test samples, together with sulphur and arsenic deportments by sulphur and arsenic bearing mineral species, are summarized in Table 1 to 2 and Figure 1 on the following pages of this letter. All the information produced by this study are shown in three appendices attached at the end of this letter:

Appendix I – Sample Origin and Methodology
Appendix II – QEMSCAN Bulk Mineral Analysis (BMA) Data
Appendix III – X-Ray Diffraction (XRD) Analysis Data.

Thank you for inviting BV Minerals – Metallurgical Division to participate in this mineralogical testing program. If you have any questions regarding this study or our assessment of the data, please do not hesitate to contact us.

Kind regards,

Wendy Ma, M.Sc. P. Geo.
Mineralogy Manager

TABLE 1
CHEMICAL COMPOSITION OF THE THREE TEST SAMPLES

Element	Symbol	AOB969-4646-01	AOB970-4646-02	AOB971-4646-03
Arsenic	As	0.36	0.11	0.08
Copper	Cu	0.15	0.05	0.03
Iron	Fe	14.4	5.73	4.54
Sulphur	S	2.58	0.73	0.49
Carbon	C	0.58	0.43	0.42
Aluminum	Al	4.98	7.01	7.17
Calcium	Ca	3.60	2.61	2.44
Potassium	K	1.81	2.73	2.86
Magnesium	Mg	0.70	0.53	0.49
Sodium	Na	0.57	1.89	2.05
Silicon	Si	25.3	30.0	30.6
Titanium	Ti	0.26	0.23	0.22
Phosphorus	P	0.06	0.05	0.05

TABLE 2
MINERAL COMPOSITION OF THE THREE TEST SAMPLES

Sulphide Minerals (wt. %)	AOB969-4646-01	AOB970-4646-02	AOB971-4646-03
Chalcopyrite	0.36	0.11	0.15
Pyrite	0.94	0.43	0.17
Pyrrhotite	4.39	1.41	0.96
Arsenopyrite	0.34	0.07	0.19
Other Sulphides	0.03	0.02	0.02
Sulphide Total	**6.06**	**2.03**	**1.48**
Fe-Sulphate (Jarosite)	1.83	0.23	0.13
Iron Oxides	6.39	2.06	1.42
Ilvaite	6.90	1.55	1.25
Quartz	29.3	29.9	31.0
Muscovite	15.5	13.5	12.2
Plagioclase Feldspar	3.66	19.7	22.7
K-Feldspar	3.72	13.7	15.2
Amphibole/Pyroxene	12.3	5.60	3.84
Chlorite	7.00	5.29	4.91
Biotite/Phlogopite	0.85	1.63	1.46
Epidote	1.28	0.87	0.89
Kaolinite	0.37	0.71	0.73
Kirschsteinite?	1.30	0.43	0.27
Calcite	1.51	1.30	1.20
Titanite/Sphene	0.75	0.59	0.61
Apatite	0.32	0.30	0.31
Others	0.90	0.54	0.52
Non-Sulphide Total	93.9	98.0	98.5

.Note: 1) Chalcopyrite includes trace amounts of Bornite, Chalcocite/Covellite and Enargite/Tennantite

.Other Sulphides include Sphlaerite, Galena, Cobaltite and Bismuthinite (2

.Iron Oxides include Iron Metals, Hematite, Geothite, Ilmenite and Magnetite (3

.Calcite includes trace amounts of Dolomite and Ankerite (4

.Others includes trace amount of Zircon, Ce-Phosphate (Monazite), and unresolved mineral species (5

FIGURE 1A
SULPHUR DEPORTMENT BY THE SULPHUR BEARING MINERAL SPECIES

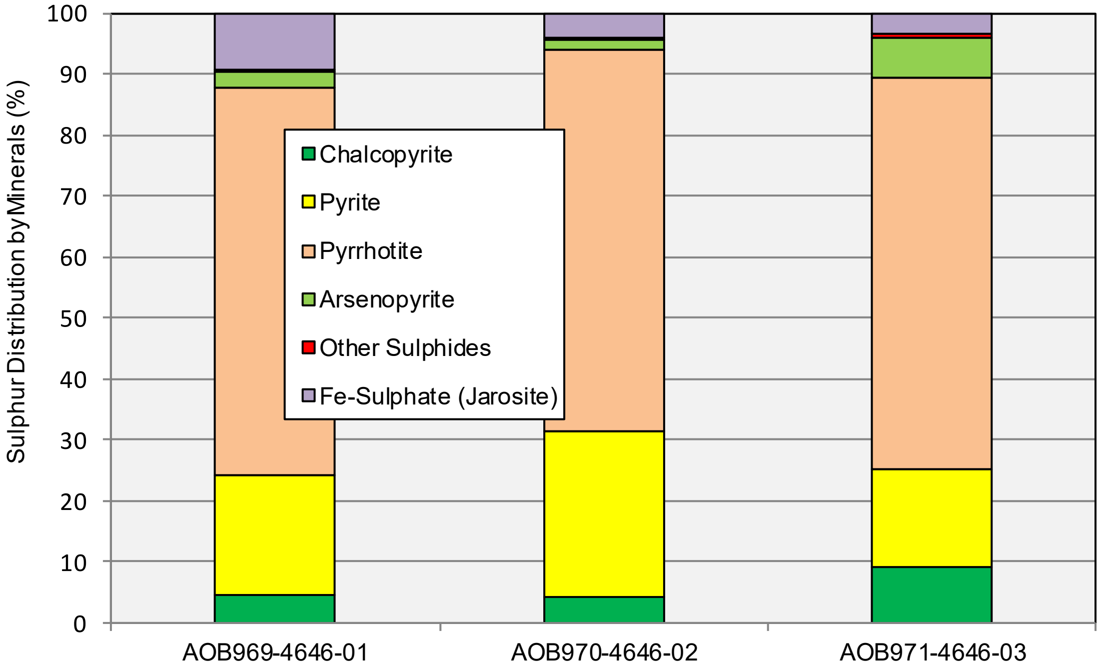
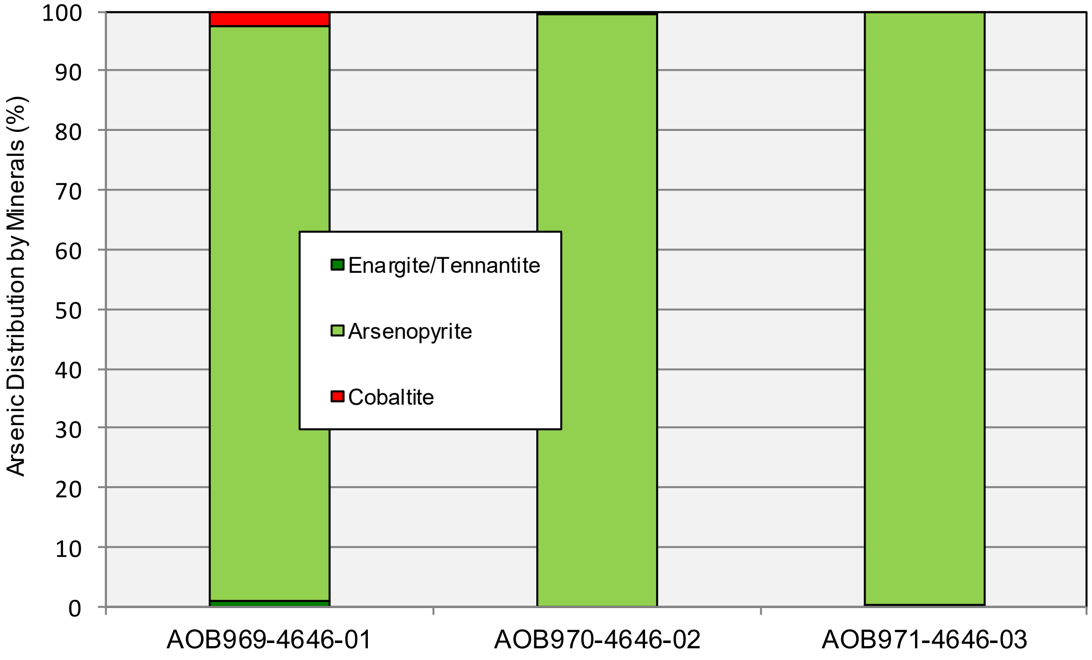


FIGURE 1B
ARSENIC DEPORTMENT BY THE ARSENIC BEARING MINERAL SPECIES



MINERALOGICAL ASSESSMENTS OF THREE TEST SAMPLES
Peak Gold - Kinross - Manh Choh - Ore Samples HCTs - C207283

APPENDIX I

SAMPLE ORIGIN AND METHDOLOGY

JUNE 23, 2022

1. Sample Origin and Methodology:

Three test samples, labeled as AOB969-4646-01, AOB970-4646-02 and AOB971-4646-03, were received on June 3, 2022 for the mineralogical assessment at the BV-Metallurgical Division in Canada. These three test samples were generated from the Acid Rock Drainage (ARD) tests (C207283) at BV Labs in Burnaby for Peak Gold - Kinross - Manh Choh project.

Upon receipt of the samples, a couple representative cuts were taken from each sample for the chemical and mineralogical analysis. The standard chemical analysis protocols for ICP Scan (MA270), S(t)&C(t) and Whole Rock Analysis (WRA) by Lithium Barite Fusion method, were conducted on each of the three samples.

Each of the unsized samples as received was mounted into a 30mm block using epoxy. During the mounting, graphite was added into each sample block in order to decrease the particle touching and the settlement of mineral particles with relatively high specific gravity. The mounted sample blocks were ground, polished and carbon coated following the standard QEMSCAN sample preparation procedures.

Following the sample preparations, the QEMSCAN Bulk Mineral Analysis (BMA) was then performed on each of the three test samples. The SIP (Specific Identification Protocols) or mineral list was particularly developed to determine the mineral compositions of these three test samples. The data, generated from the QEMSCAN Bulk Mineral Analysis (BMA), can be located in Appendix II.

The X-Ray Diffraction Analysis (XRD) was also performed the each of the three test samples to assist the QEMSCAN calibrations for non-sulphide gangue. The XRD data can be located in Appendix III.

MINERALOGICAL ASSESSMENTS OF THREE TEST SAMPLES
Peak Gold - Kinross - Manh Choh - Ore Samples HCTs - C207283

APPENDIX II

QEMSCAN BULK MINERAL ANALYSIS (BMA) DATA

JUNE 23, 2022

TABLE 1
MINERAL COMPOSITION OF THE THREE TEST SAMPLES
ME2203006

Minerals	Mineral Compositions (wt. %)		
	AOB969-4646-01	AOB970-4646-02	AOB971-4646-03
Chalcopyrite	0.36	0.11	0.15
Pyrite	0.94	0.43	0.17
Pyrrhotite	4.39	1.41	0.96
Arsenopyrite	0.34	0.07	0.19
Other Sulphides	0.03	0.02	0.02
Fe-Sulphate (Jarosite)	1.83	0.23	0.13
Iron Oxides	6.39	2.06	1.42
Ilvaite	6.90	1.55	1.25
Quartz	29.3	29.9	31.0
Muscovite	15.5	13.5	12.2
Plagioclase Feldspar	3.66	19.7	22.7
K-Feldspar	3.72	13.7	15.2
Amphibole/Pyroxene	12.3	5.60	3.84
Chlorite	7.00	5.29	4.91
Biotite/Phlogopite	0.85	1.63	1.46
Epidote	1.28	0.87	0.89
Kaolinite	0.37	0.71	0.73
Kirschsteinite?	1.30	0.43	0.27
Calcite	1.51	1.30	1.20
Titanite/Sphene	0.75	0.59	0.61
Apatite	0.32	0.30	0.31
Others	0.90	0.54	0.52
Total	100.0	100.0	100.0

Note: 1) Chalcopyrite includes trace amounts of Bornite, Chalcocite/Covellite and Enargite/Tennantite.
2) Other Sulphides include Sphlaerite, Galena, Cobaltite and Bismuthinite.
3) Iron Oxides include Iron Metals, Hematite, Geothite, Ilmenite and Magnetite.
4) Calcite includes trace amounts of Dolomite and Ankerite.
5) Others includes trace amount of Zircon, Ce-Phosphate (Monazite), and unresolved mineral species.

TABLE 2A
SULPHUR DISTRIBUTION BY SULPHUR BEARING MINERALS

Mineral	Sulphur Distribution of Total Sulphur (%)		
	AOB969-4646-01	AOB970-4646-02	AOB971-4646-03
Chalcopyrite	4.7	4.4	9.3
Pyrite	19.4	26.9	15.9
Pyrrhotite	63.8	62.7	64.2
Arsenopyrite	2.5	1.5	6.4
Other Sulphides	0.3	0.6	0.9
Fe-Sulphate (Jarosite)	9.3	3.9	3.2
Total	100.0	100.0	100.0

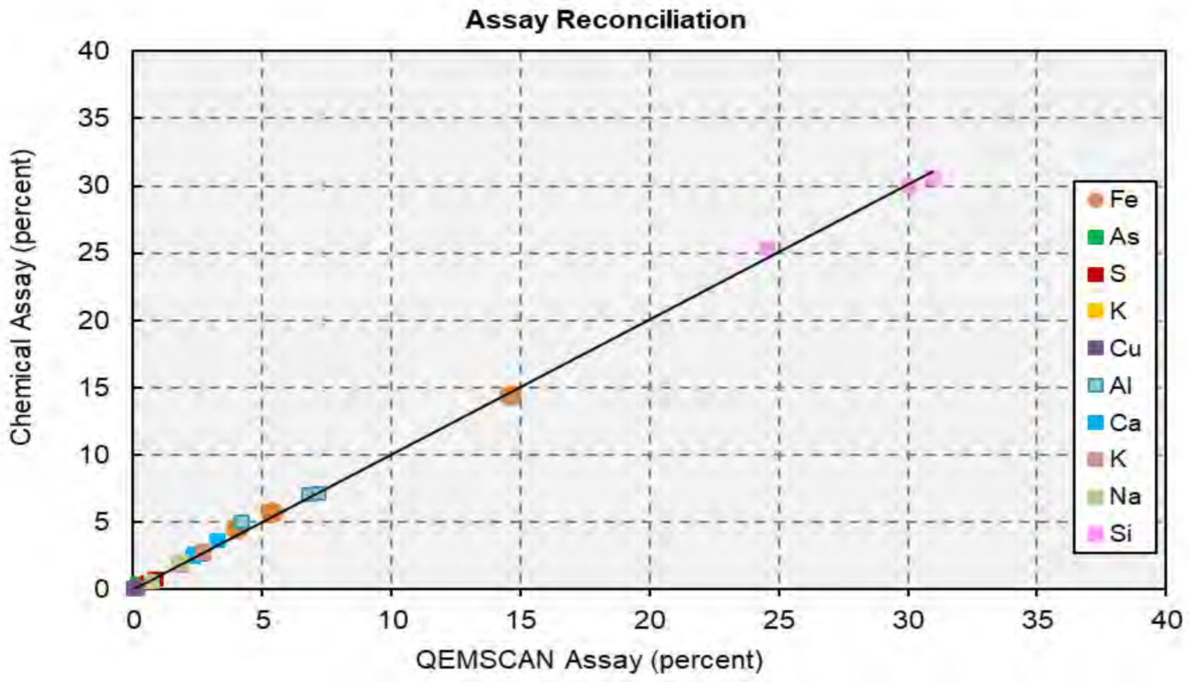
Note: 1) Chalcopyrite includes trace amounts of Bornite, Chalcocite/Covellite and Enargite/Tennantite.
2) Other Sulphides include Sphlaerite, Galena, Cobaltite and Bismuthinite.
3). Fe-Sulphate (Jarosite) includes trace amounts of Barite and Ca-Sulphate.

TABLE 2B
ARSENIC DISTRIBUTION BY ARSENIC BEARING MINERALS

Mineral	Arsenic Distribution of Total Arsenic (%)		
	AOB969-4646-01	AOB970-4646-02	AOB971-4646-03
Enargite/Tennantite	1.1	0.0	0.2
Arsenopyrite	96.4	99.4	99.6
Cobaltite	2.6	0.6	0.2
Total	100.0	100.0	100.0

TABLE 3
ASSAY RESULTS AND RECONCILIATION

Element	Assay Methods	Chemical Assays (%)		
		AOB969-4646-01	AOB970-4646-02	AOB971-4646-03
Al	QEMSCAN	4.22	6.83	7.17
	Chemical	4.98	7.01	7.17
As	QEMSCAN	0.16	0.03	0.09
	Chemical	0.36	0.11	0.08
C	QEMSCAN	0.19	0.15	0.14
	Chemical	0.58	0.43	0.42
Ca	QEMSCAN	3.27	2.39	2.30
	Chemical	3.60	2.61	2.44
Cu	QEMSCAN	0.13	0.04	0.06
	Chemical	0.15	0.05	0.03
Fe	QEMSCAN	14.6	5.34	3.99
	Chemical	14.4	5.73	4.54
K	QEMSCAN	1.81	2.71	2.72
	Chemical	1.81	2.73	2.86
Mg	QEMSCAN	0.97	0.66	0.60
	Chemical	0.70	0.53	0.49
Na	QEMSCAN	0.73	1.76	1.89
	Chemical	0.57	1.89	2.05
P	QEMSCAN	0.06	0.05	0.06
	Chemical	0.06	0.05	0.05
S	QEMSCAN	2.59	0.85	0.56
	Chemical	2.58	0.73	0.49
Si	QEMSCAN	24.5	30.1	30.9
	Chemical	25.3	30.0	30.6
Ti	QEMSCAN	0.25	0.18	0.20
	Chemical	0.26	0.23	0.22



MINERALOGICAL ASSESSMENTS OF THREE TEST SAMPLES
Peak Gold - Kinross - Manh Choh - Ore Samples HCTs - C207283

APPENDIX III

X-RAY DIFFRACTION (XRD) ANALYSIS DATA

JUNE 23, 2022

EXPERIMENTAL METHOD

The 3 samples of **Project C207283** were reduced to the optimum grain-size range for quantitative X-ray analysis (<10 μm) by grinding under ethanol in a vibratory McCrone XRD Mill (Retsch GmbH, Germany) for 10 minutes. Continuous-scan X-ray powder-diffraction data were collected over a range 3-80°2θ with CoKα radiation on a Bruker D8 Advance Bragg-Brentano diffractometer equipped with an Fe filter foil, 0.6 mm (0.3°) divergence slit, incident- and diffracted-beam Soller slits and a LynxEye-XE detector. The long fine-focus Co X-ray tube was operated at 35 kV and 40 mA, using a take-off angle of 6°.

RESULTS

The X-ray diffractograms were analyzed using the International Centre for Diffraction Database PDF-4+ and Search-Match software by Bruker. X-ray powder-diffraction data of the samples were refined with Rietveld program Topas 4.2 (Bruker AXS). The results of quantitative phase analysis by Rietveld refinements are given in Table 1. These amounts represent the relative amounts of crystalline phases normalized to 100%. The Rietveld refinement plots are shown in Figures 1 to 3.

Note that the X-ray diffraction pattern of sample #1 is affected by the presence of some unknown clay mineral(s), likely chlorite-smectite, which could not be analyzed (see a hump fitted with a calculated peak - position is marked with a vertical blue line between 5-10º2θ in Figure 1). The results should be considered approximate.

Table 1. Results of quantitative phase analysis (wt.%):

Mineral	**Ideal Formula**	**#1** **AOB969-4646-001**	**#2** **AOB970-4646-002**	**#3** **AOB971-4646-003**
Arsenopyrite	$FeAsS$		0.5 (?)	0.5
Biotite	$K(Mg,Fe^{2+})_3AlSi_3O_{10}(OH)_2$	3.0	2.0	2.5
Calcite	$CaCO_3$	4.9	3.8	3.7
Clinochlore	$(Mg,Fe^{2+})_5Al(Si_3Al)O_{10}(OH)_8$	4.6	2.4	2.6
Ferroactinolite	$Ca_2Fe_5^{2+}Si_8O_{22}(OH)_2$	8.1	2.4	1.7
Goethite	$\alpha\text{-}Fe^{3+}O(OH)$	3.4		
Gypsum	$CaSO_4 \cdot 2H_2O$	1.0		
Illite-Muscovite 2M1	$K_{0.65}Al_{2.0}Al_{0.65}Si_{3.35}O_{10}(OH)_2\text{-}KAl_2AlSi_3O_{10}(OH)_2$	8.6	6.9	6.5
Ilmenite	$Fe^{2+}TiO_3$	0.8 (?)		
Kaolinite	$Al_2Si_2O_5(OH)_4$	2.4	1.1	1.1
K-feldspar	$KAlSi_3O_8$	7.8	15.3	15.9
Magnetite	Fe_3O_4	0.3		
Plagioclase (albite; albite, calcian)	$NaAlSi_3O_8 – CaAl_2Si_2O_8$	8.6	27.9	29.7
Pyrite	FeS_2	1.3	0.4	0.2 (?)
Pyrrhotite	$Fe_{1-x}S$	5.2	1.4	1.0
Quartz	SiO_2	38.7	34.9	33.6
Stilpnomelane	$K(Fe^{2+},Mg,Fe^{3+})_8(Si,Al)_{12}(O,OH)_{27}$	0.2		0.1
Titanite	$CaTiSiO_5$	1.1	1.0 (?)	0.9 (?)
Total		**100.0**	**100.0**	**100.0**

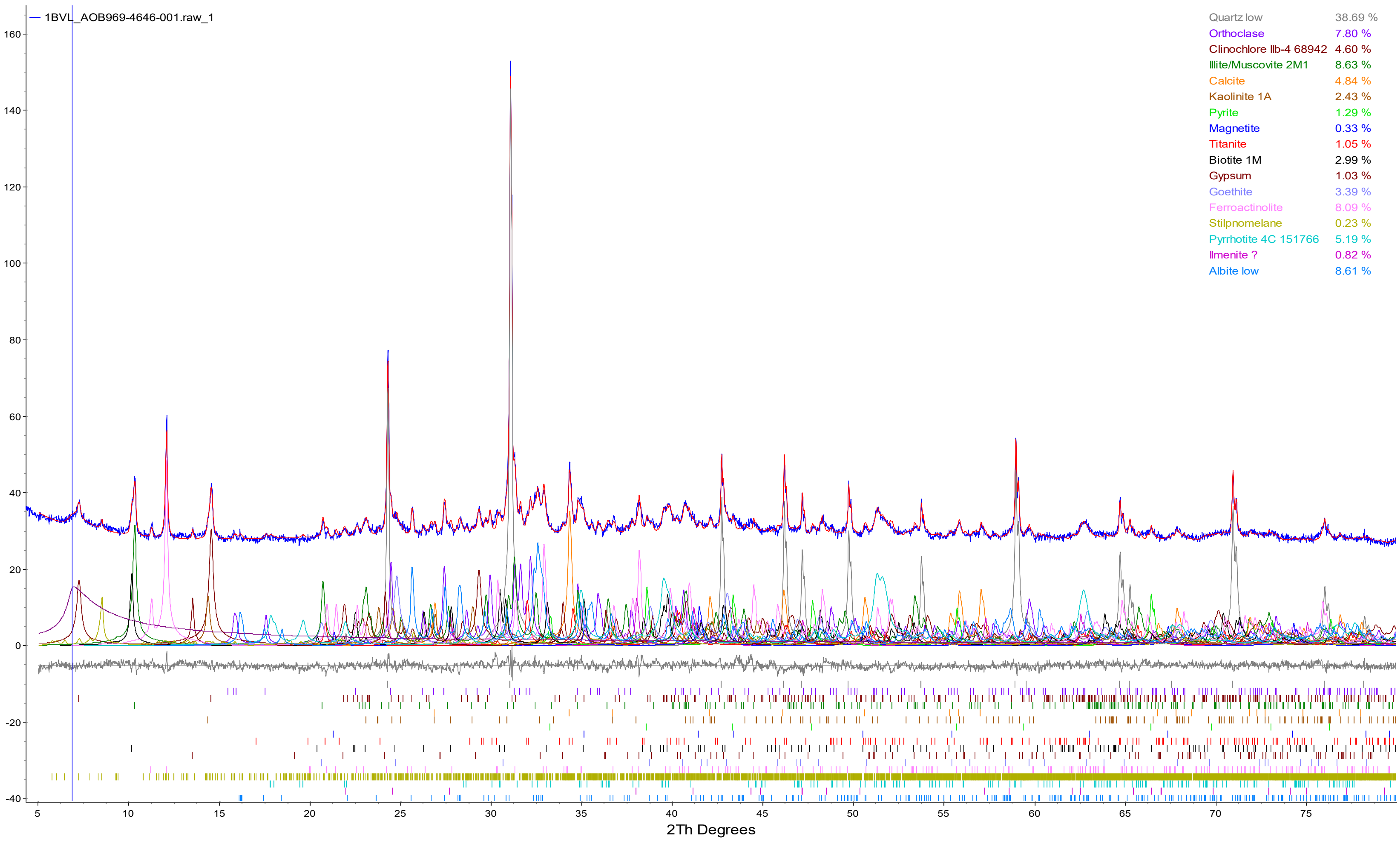


Figure 1. Rietveld refinement plot of sample **BV Labs #1: AOB969-4646-001** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below - difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections; vertical blue line - position of peaks phase). Coloured lines are individual diffraction patterns of all phases.

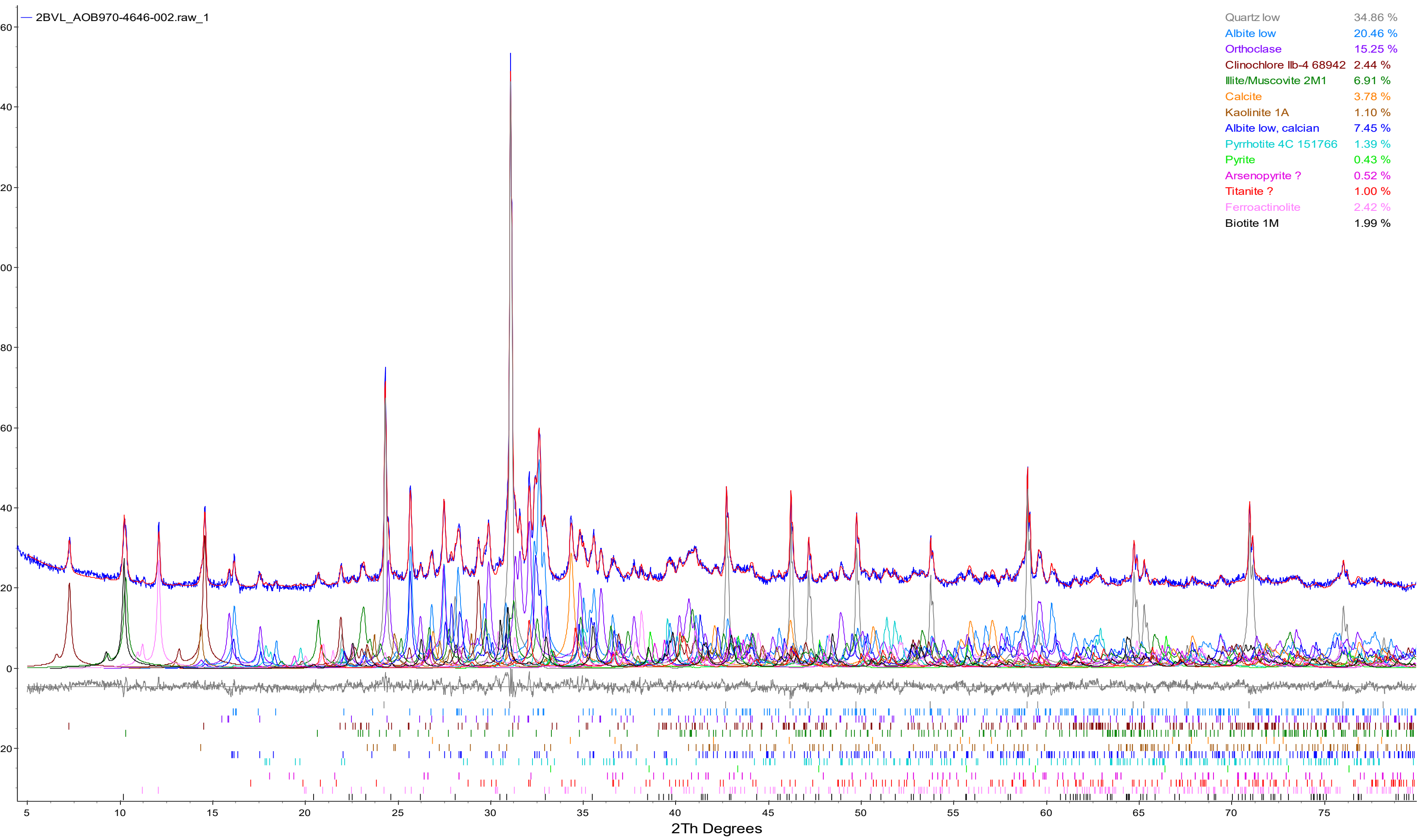


Figure 2. Rietveld refinement plot of sample **BV Labs #2: AOB970-4646-002** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below - difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

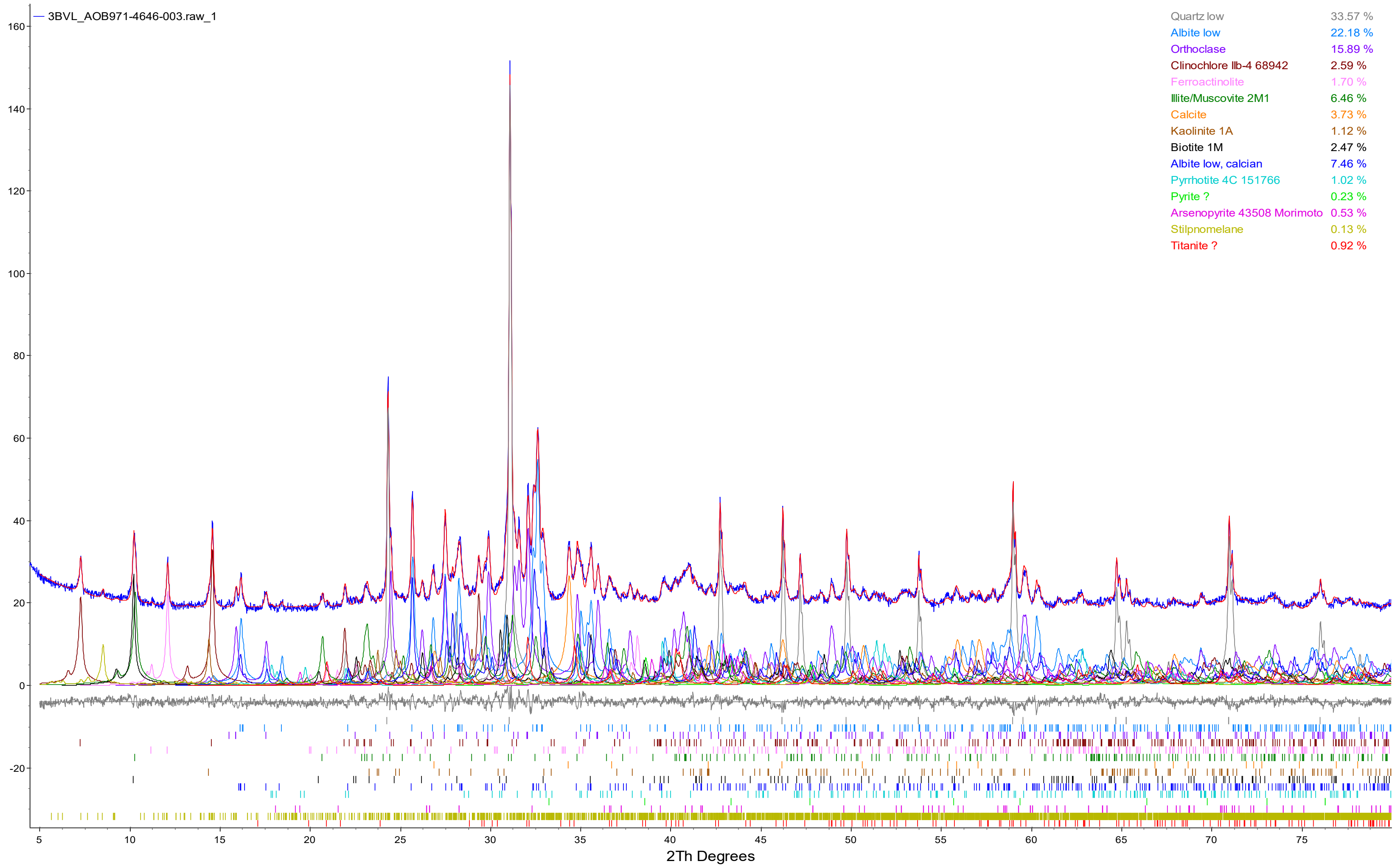


Figure 3. Rietveld refinement plot of sample **BV Labs #3: AOB971-4646-003** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below - difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

Ultra Petrography
& Geoscience Inc.

Report for: Bureau Veritas Laboratories

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Petrographic Report on 3 Aggregate Samples for Bureau Veritas Laboratories

Ref: C207283-Kinross Manh Choh

Petrographic Report 220109

Effective Date: May 30, 2022

This report consists of 10 pages, and was signed and sealed at Vancouver on May 30, 2022 by:

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Table of Contents

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1. Introduction

Mr. Jason Wai of Bureau Veritas submitted 3 aggregate samples to Vancouver Petrographics for petrographic analysis. Mr. Wai did not provide the provenance of the samples, a geological introduction to the area where they were gathered, or multi-elemental geochemical analysis related to the samples.

The modal percentages (see Petrographic descriptions attached below) were determined by popint-counting analysis.

2. Petrographic Descriptions

Sample 1: A0B969-4646-001

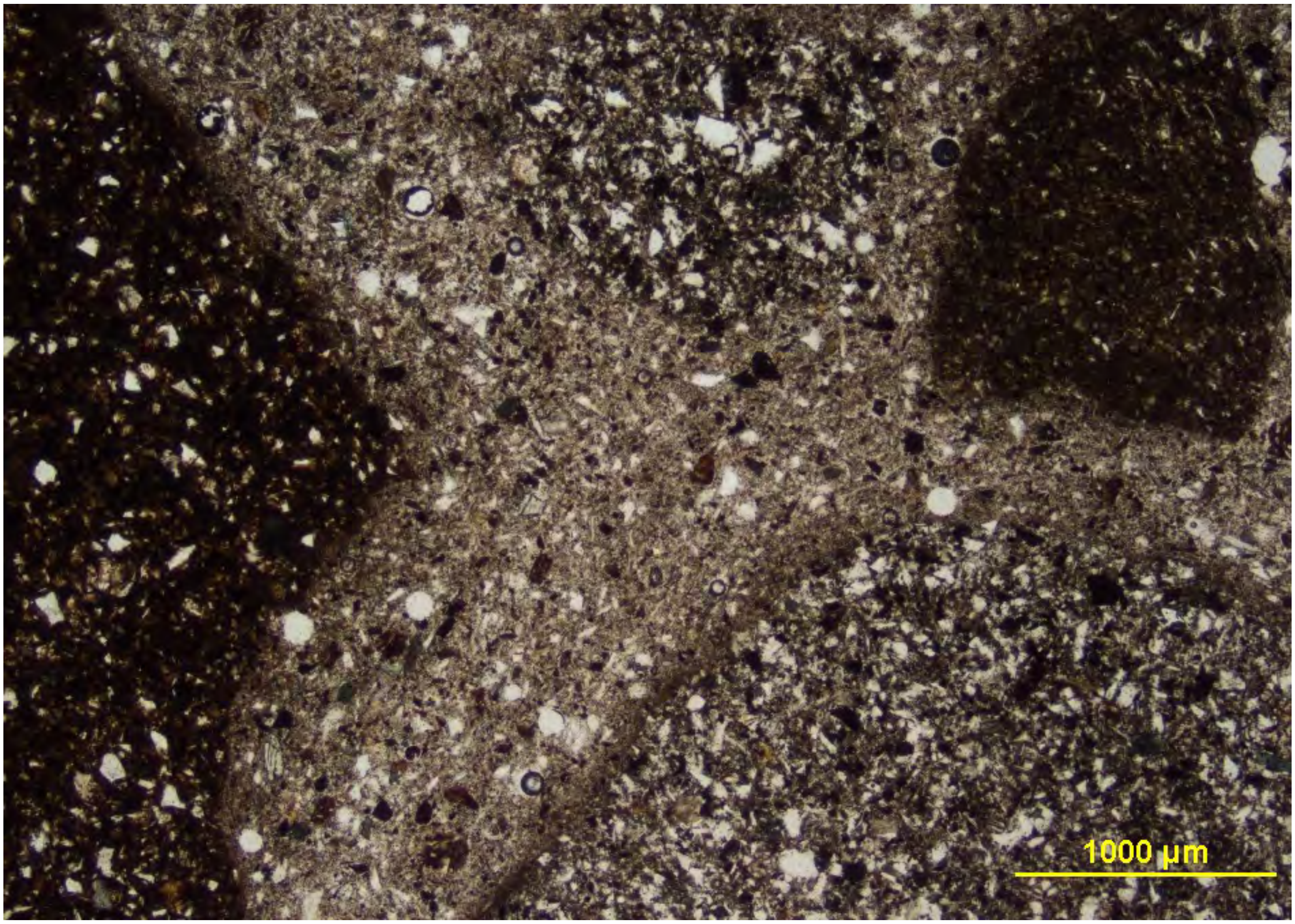
This section comprises angular fragments of very fine-grained sandstone ranging from 0.1 mm across to 6 mm long and very fine-grained dispersions of angular fragments of quartz, feldspar, white mica, amphibole, chalcopyrite, biotite, carbonate, pyrite, pyrrhotite, and iron oxides.

The rock fragments consist of very fine-grained sandstone and can be subdivided in a clay-material-rich sandstone with subordinate angular clasts of quartz, iron oxides and limonitic material and amphibole, and quartz-rich sandstone hosting subordinate amounts of amphibole, pyrrhotite, chalcopyrite, and carbonate.

The dispersed crystal fragments not enclosed in the sandstone fragments are mostly liberated; therefore, the sulphides (mostly chalcopyrite, pyrrhotite, pyrite, and sphalerite) are liberated as well as are the carbonate and oxides.

Mineral	***Modal %***	***Size Range (mm)***
lithic fragment (clay+quartz+iron oxide±amphibole)	26.24	up to 6
quartz	16.34	0.004–0.15
lithic fragment (quartz±amphibole± pyrrhotite±chalcopyite±carbonate)	14.85	up to 5
Iron oxide	11.39	0.004–0.1
clay-sized material	7.43	0.004–0.1
white mica	7.43	0.004–0.1
amphibole	6.44	0.004–0.1
chalcopyrite	3.96	0.004–0.1
carbonate	1.98	0.004–0.1
biotite	1.49	0.004–0.1
epidote	1.49	0.004–0.1
feldspar	0.50	0.004–0.1
magnetite	0.50	0.004–0.1
pyrite	tr	0.004–0.1
chlorite	tr	0.004–0.1
sphalerite	tr	0.004–0.1

Mineral	***Modal %***	***Size Range (mm)***
zircon?	tr	0.01



Photomicrograph 1: The two types of sedimentary fragments are displayed together the fine-grained liberated crystal fragments dominated by silicates and subordinate sulphides (opaque).

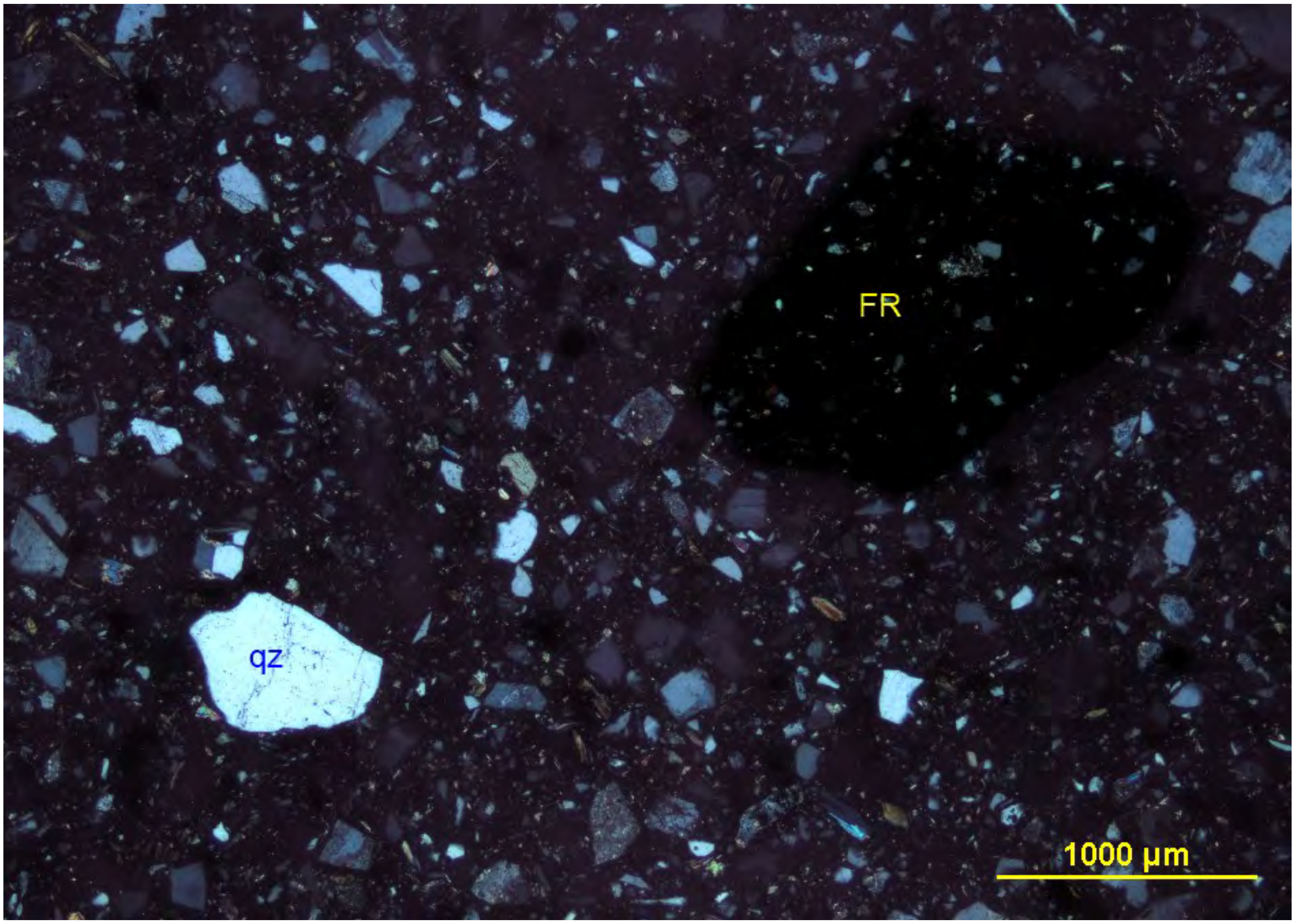
Sample 2: A0B969-4646-002

This section comprises angular crystal fragments (from 0.002 mm to 0.4 mm across) and angular lithic fragments up to 4.5 mm long. Among the crystal fragments, quartz, feldspar (undifferentiated) chlorite, iron oxides, white mica, carbonate, chalcopyrite, amphibole (actinolite?), epidote, biotite, pyrite, clay-sized material, magnetite, rutile, and sphalerite occur. The lithic fragments consist of clay-sized matrix and angular clasts of quartz and subordinate silicates and oxides).

Most of the crystals fragments are liberated. The chalcopyrite crystal fragments prevail over the other sulphides. The chalcopyrite is fresh, fractured and, in most cases, does not show signs of oxidation.

Pyrite, magnetite, and sphalerite are rare and all fresh. Rare fragment of ison oxides occur.

Mineral	***Alteration and Weathering Mineral***	***Modal %***	***Size Range (mm)***
quartz		34.31	0.002–0.4
feldspar (K-feldspar>plagioclase)	sericite and carbonate alteration)	20.59	0.002–0.4
lithic fragment (clay+quartz±iron oxide)		11.76	0.002–0.4
chlorite		8.82	up to 4.5 long
Iron oxide		5.39	0.002–0.4
white mica		5.39	0.002–0.4
lithic fragment (quartz± white mica ±chlorite ±pyrrhotite±amphibole)		5.88	up to 4.5 long
carbonate		2.94	0.002–0.4
chalcopyrite		2.94	0.002–0.4
amphibole		1.47	0.002–0.4
epidote		0.49	0.002–0.4
biotite		tr	0.002–0.4
clay-sized material		tr	0.002–0.004
magnetite		tr	0.002–0.2
pyrite		tr	0.002–0.1
rutile		tr	0.002–0.1
sphalerite		tr	0.002–0.1



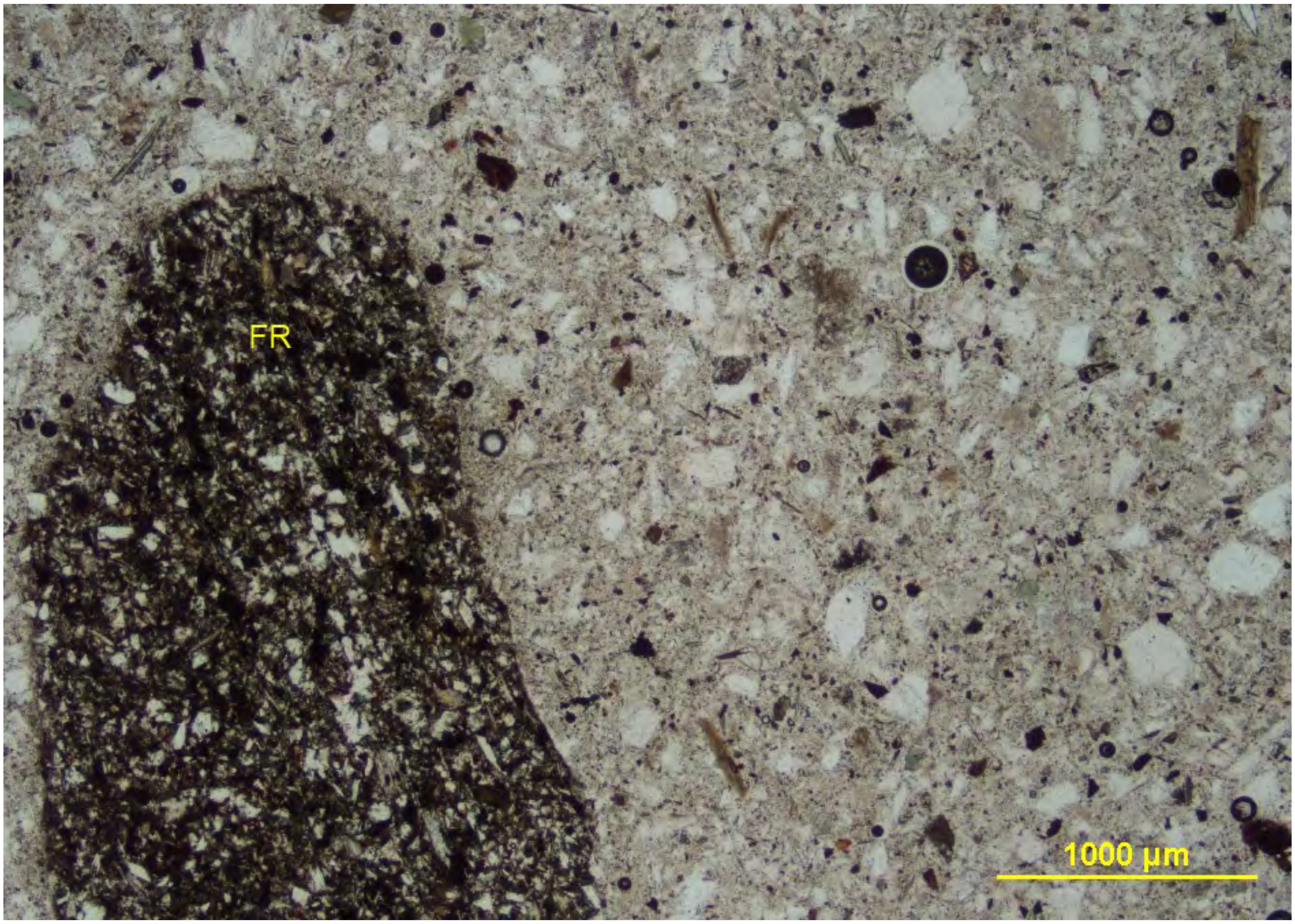
Photomicrograph 2: Sparse fragments of very fine-grained sandstone (FR) occur with angular and mostly liberated crystal fragments of quartz, feldspar and silicates. Crossed polarizers transmitted light.

Sample 3: A0B969-4646-003

In this section angular crystal fragments of quartz, feldspar, and subordinate chlorite, carbonate, iron oxide, chalcopyrite, amphibole, white mica, epidote, clay-sized material, biotite, magnetite, and trace amounts of pyrite, rutile, and sphalerite prevail over angular to sub-angular lithic fragments of fine-sandstone. Like in the previous samples, the sandstone fragments are distinguished in clay-=rich fragments host angular clasts of quartz and iron oxides and siliciclastic fragments, in which the quartz prevails over white mica, chalcopyrite, and amphibole.

Chalcopyrite is the most abundant sulphide fragment. The chalcopyrite fragments are up to 0.2 mm long, are fresh, and are liberated. Magnetite, pyrite, and sphalerite occur in trace amounts and are fresh and liberated fragments. Iron oxides fragments are spatially associated with the lithic fragments.

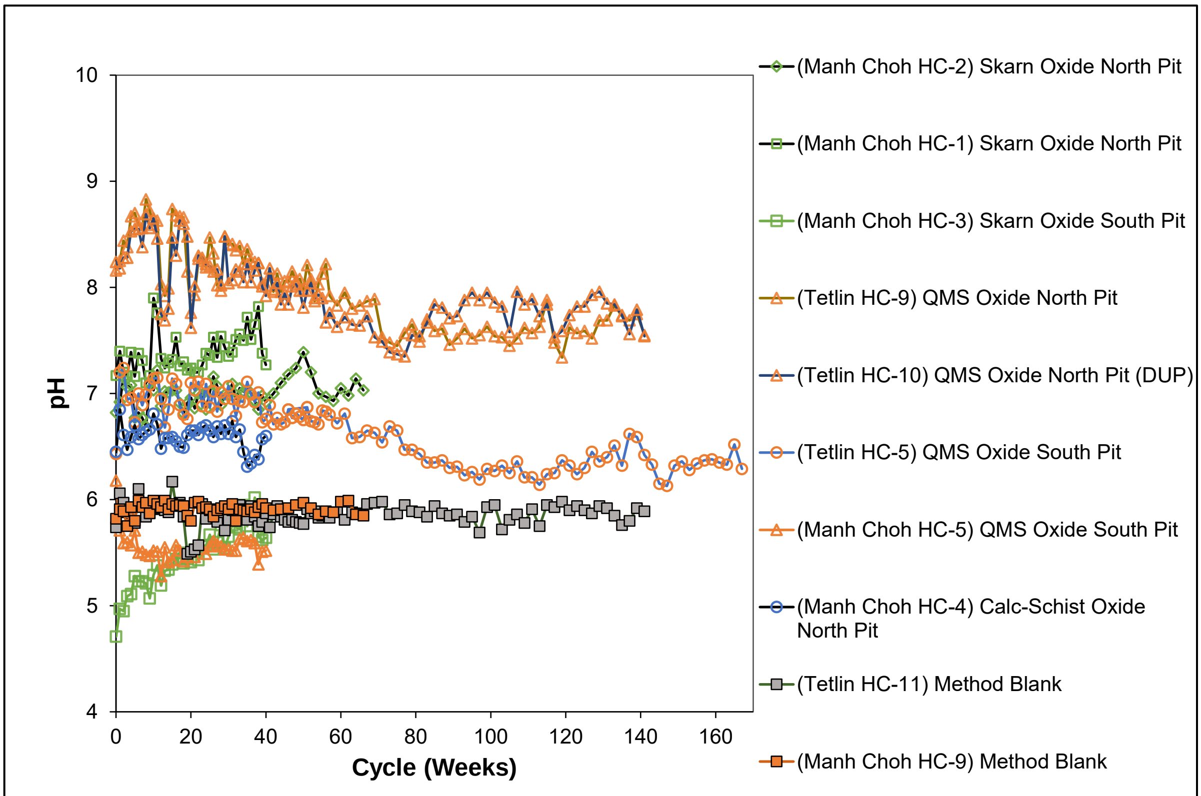
Mineral	***Alteration and Weathering Mineral***	***Modal %***	***Size Range (mm)***
quartz		33.50	0.002–1.4 long
feldspar	white mica	23.65	0.002–1
lithic fragment (clay+quartz+-iron oxide)		9.36	up to 4.5 long
lithic fragment (quartz± white mica±chalcopyrite± amphibole)		7.88	up to 4.5 long
chlorite		7.39	up to 0.4 long
carbonate		4.93	up to 0.15
Iron oxide		2.96	up to 0.15
chalcopyrite		2.95	up to 0.2 long
amphibole		2.46	up to 0.15
white mica		1.97	up to 0.15
epidote		1.48	up to 0.15
clay-sized material		0.99	up to 0.15
biotite		0.49	up to 0.5 long
magnetite		tr	up to 0.15
pyrite		tr	up to 0.15
rutile		tr	up to 0.05
sphalerite		tr	up to 0.1



Photomicrograph 3: A sub-angular fragment of very fine-grained siliciclastic sandstone (FR) occurs together with angular and fine-grained crystal fragments of quartz, feldspar and silicates. Plane-polarized transmitted light.

Appendix B: Humidity Cell Charts

Appendix B1: Humidity Cell Charts Waste Rock



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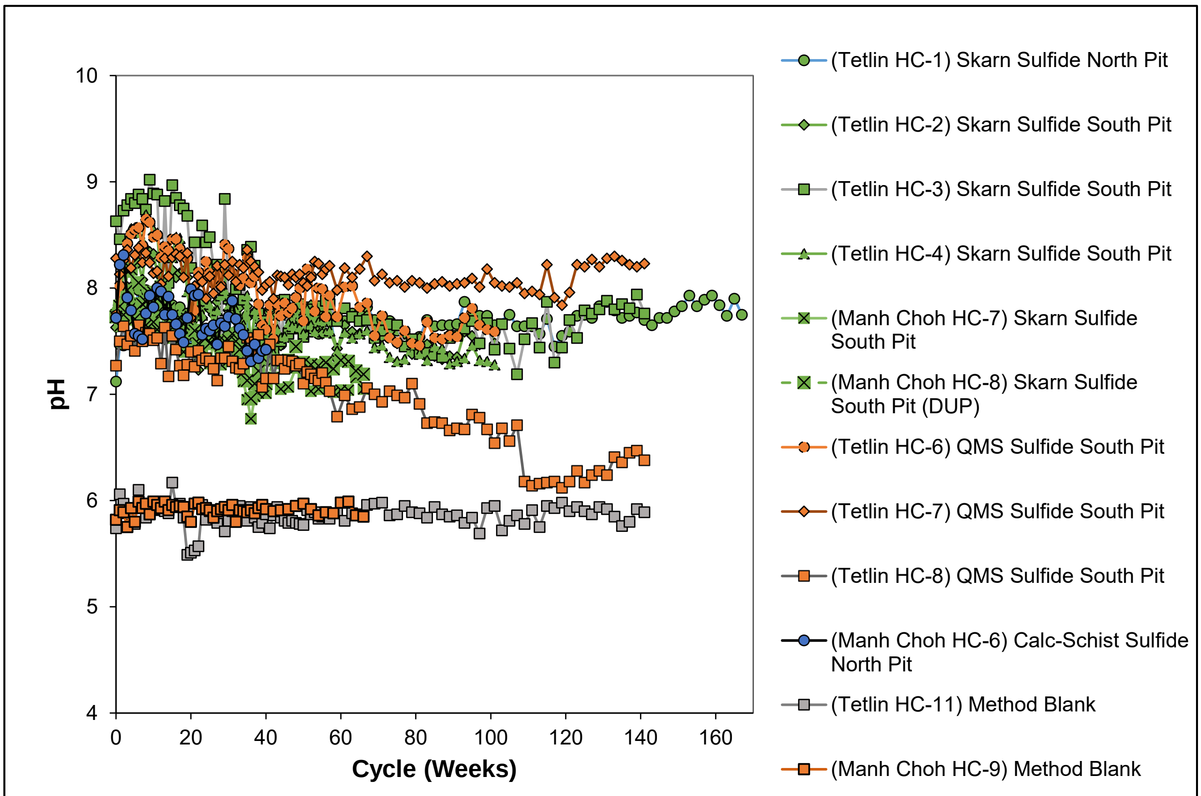

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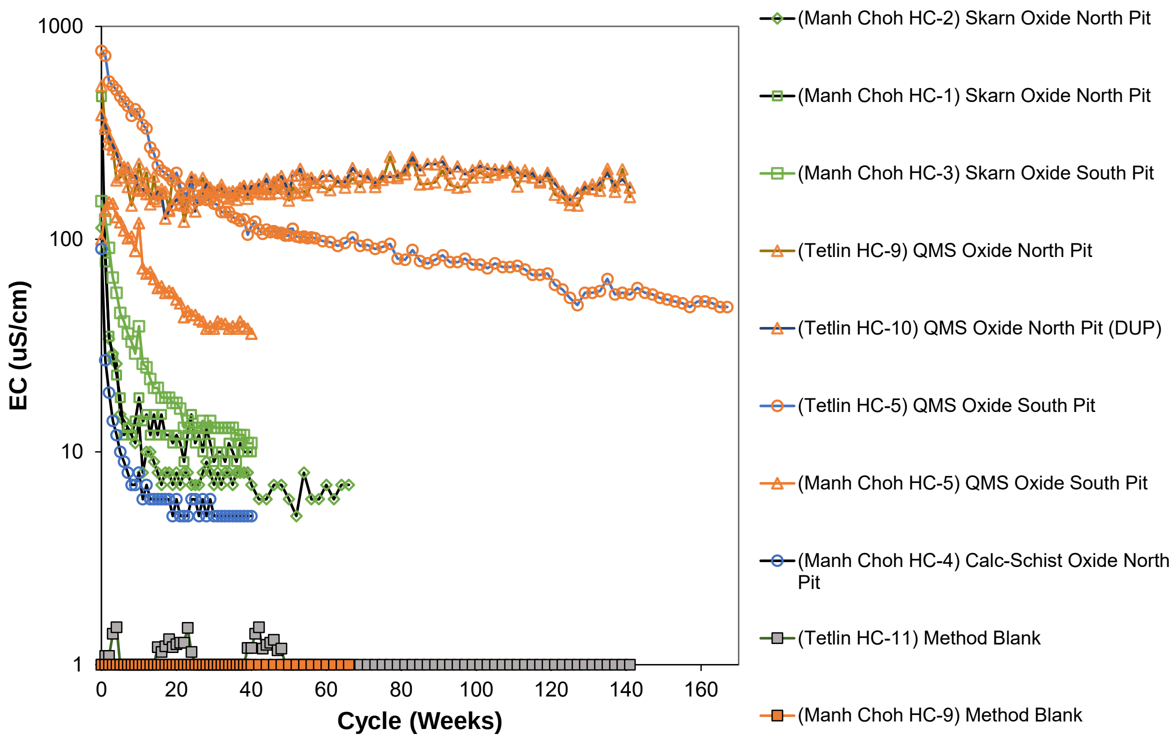

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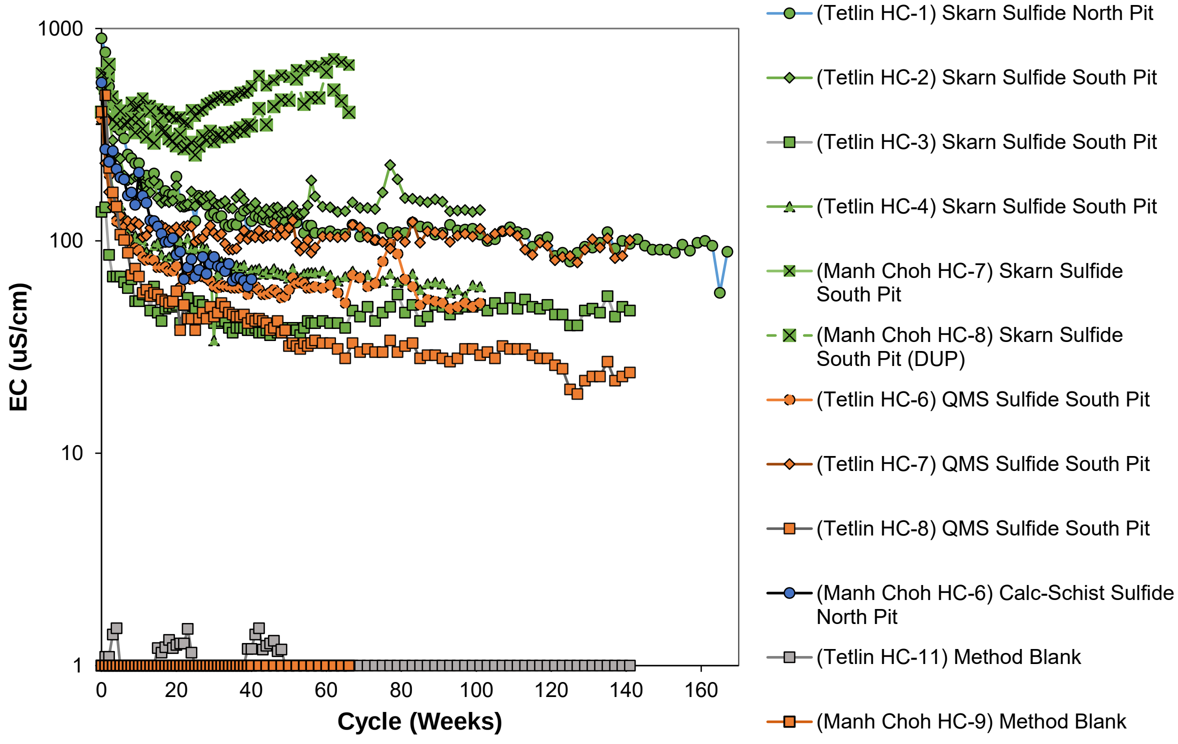

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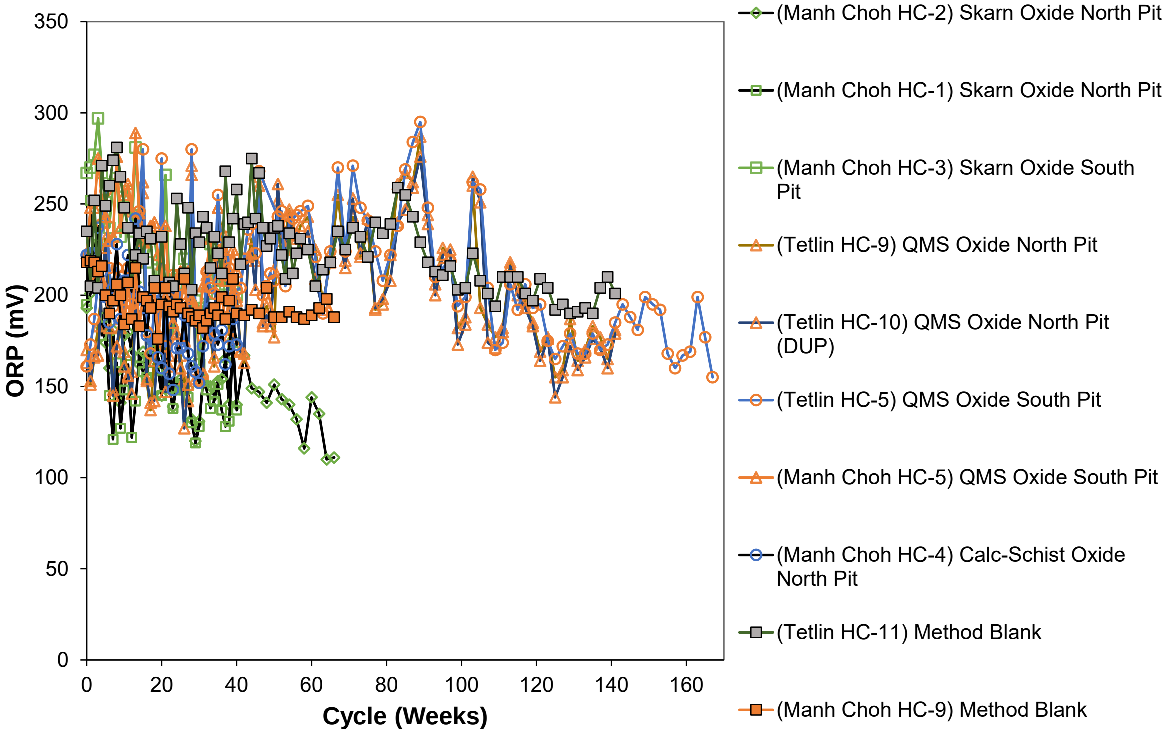

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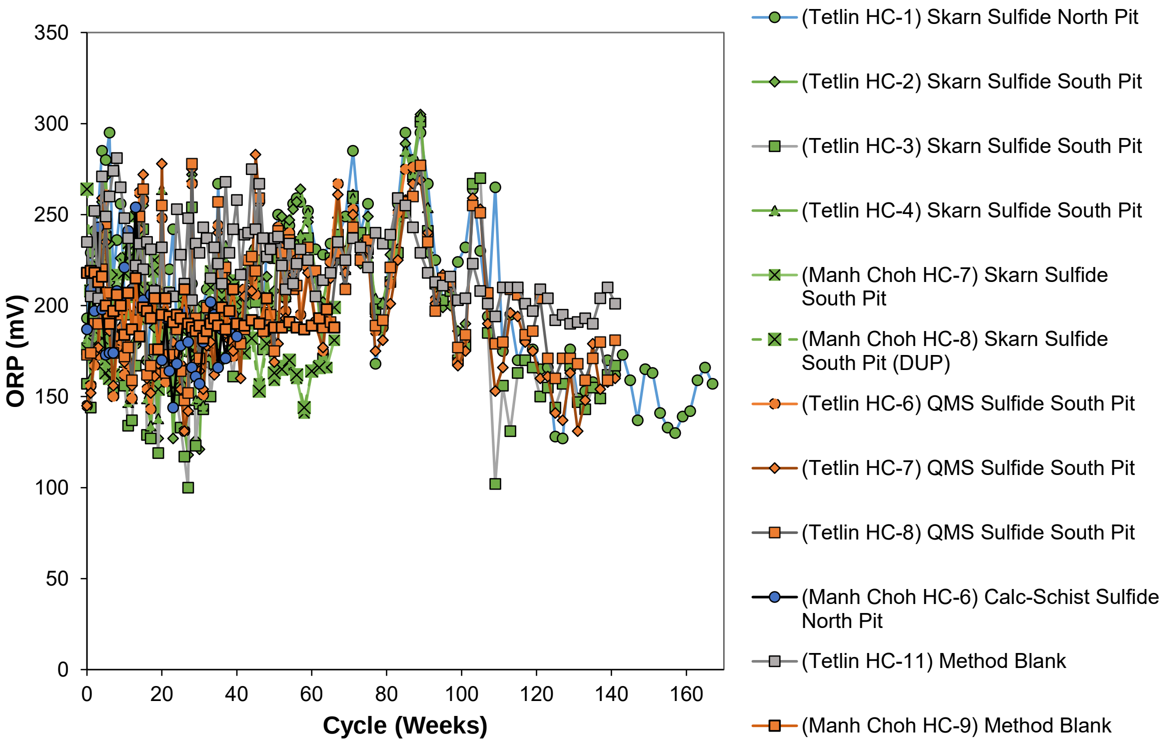

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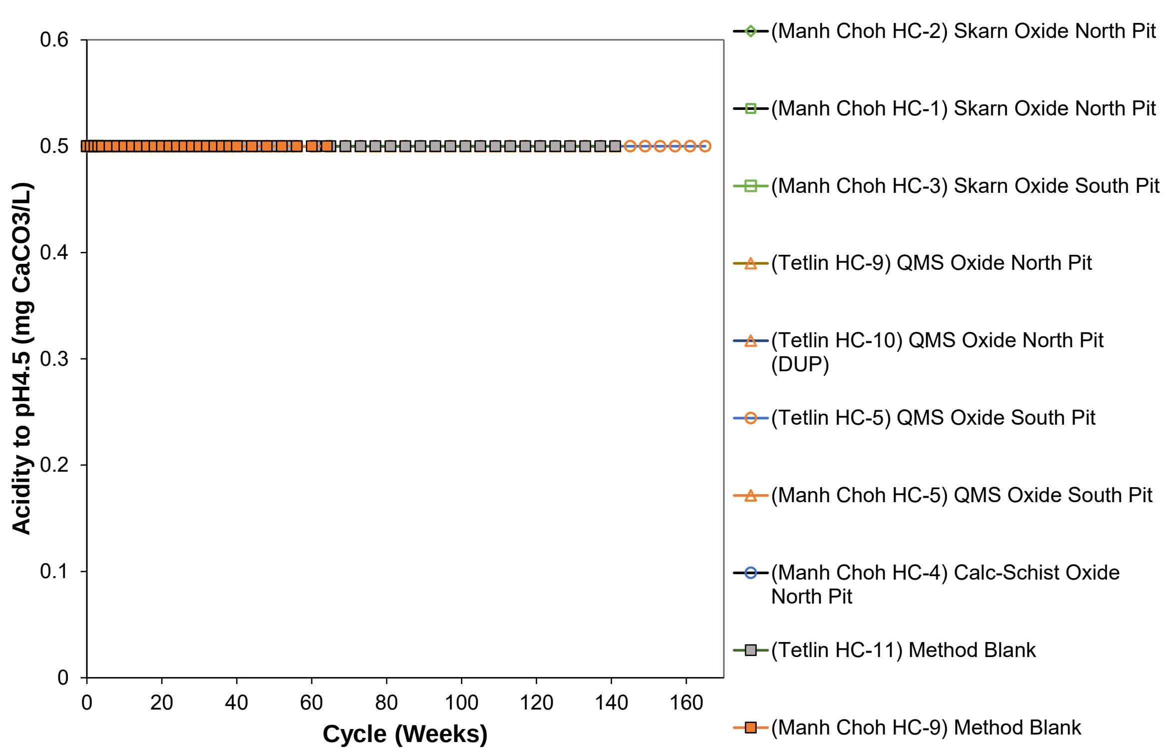

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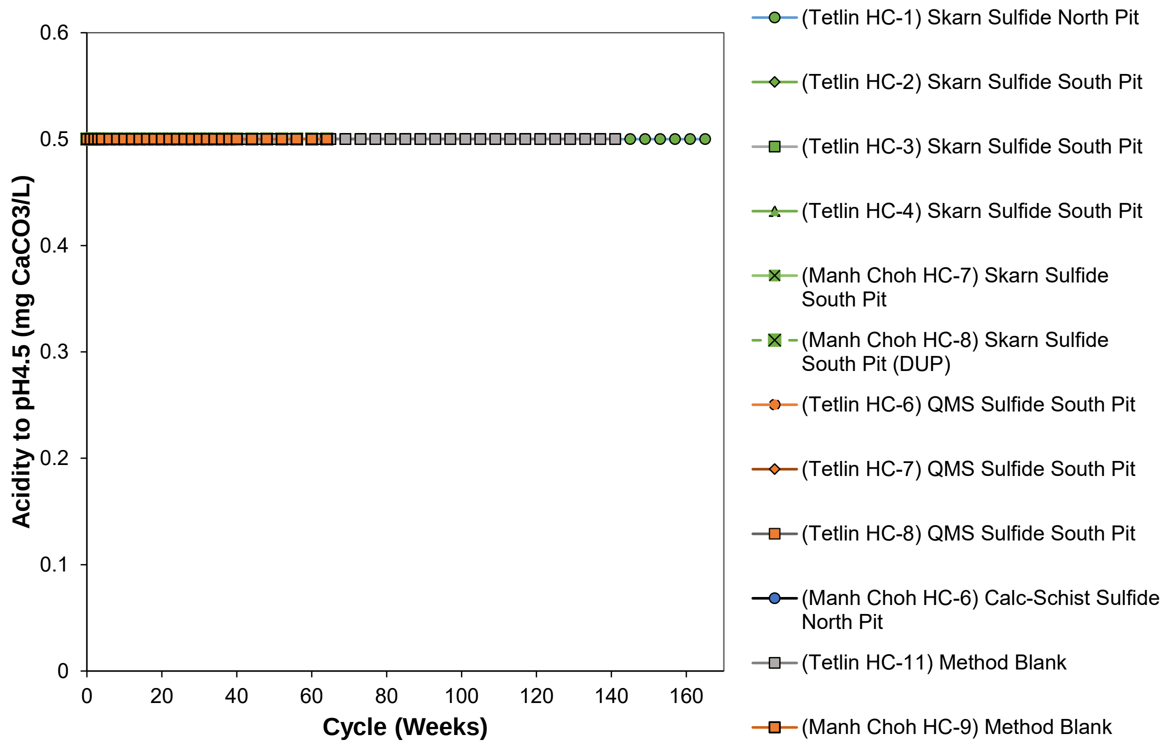

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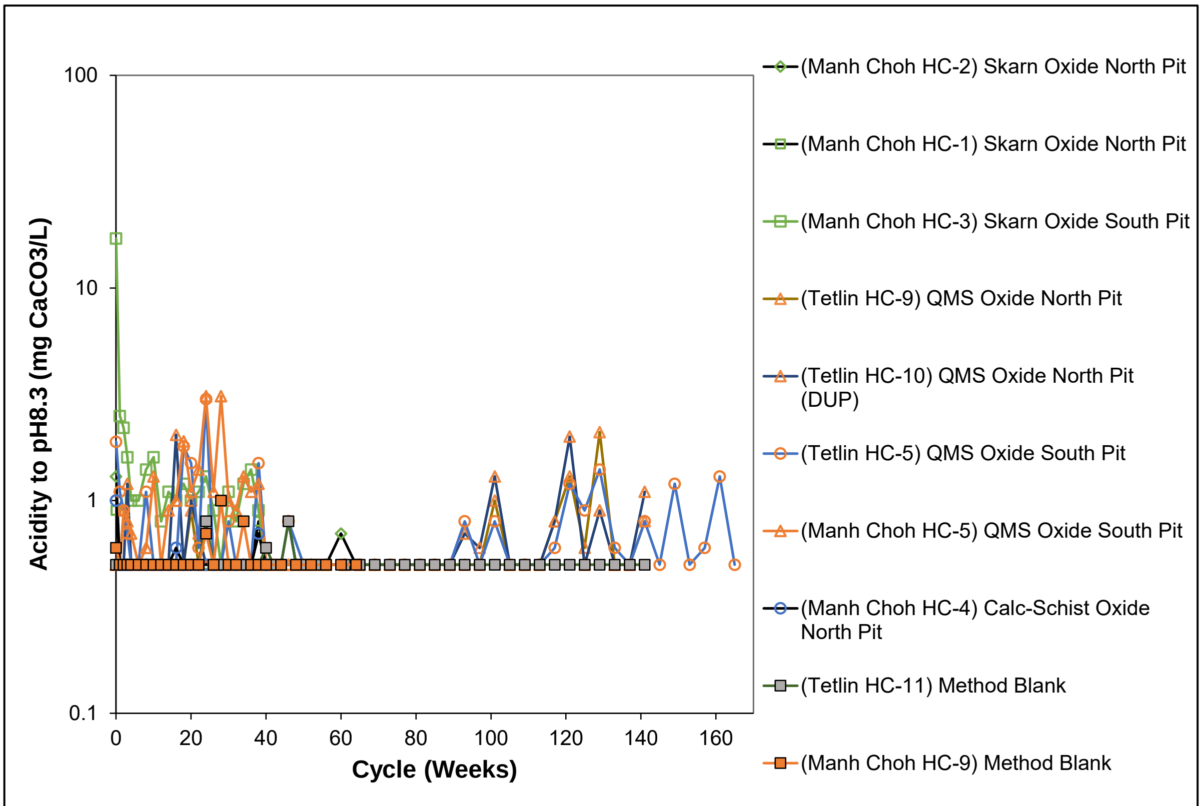

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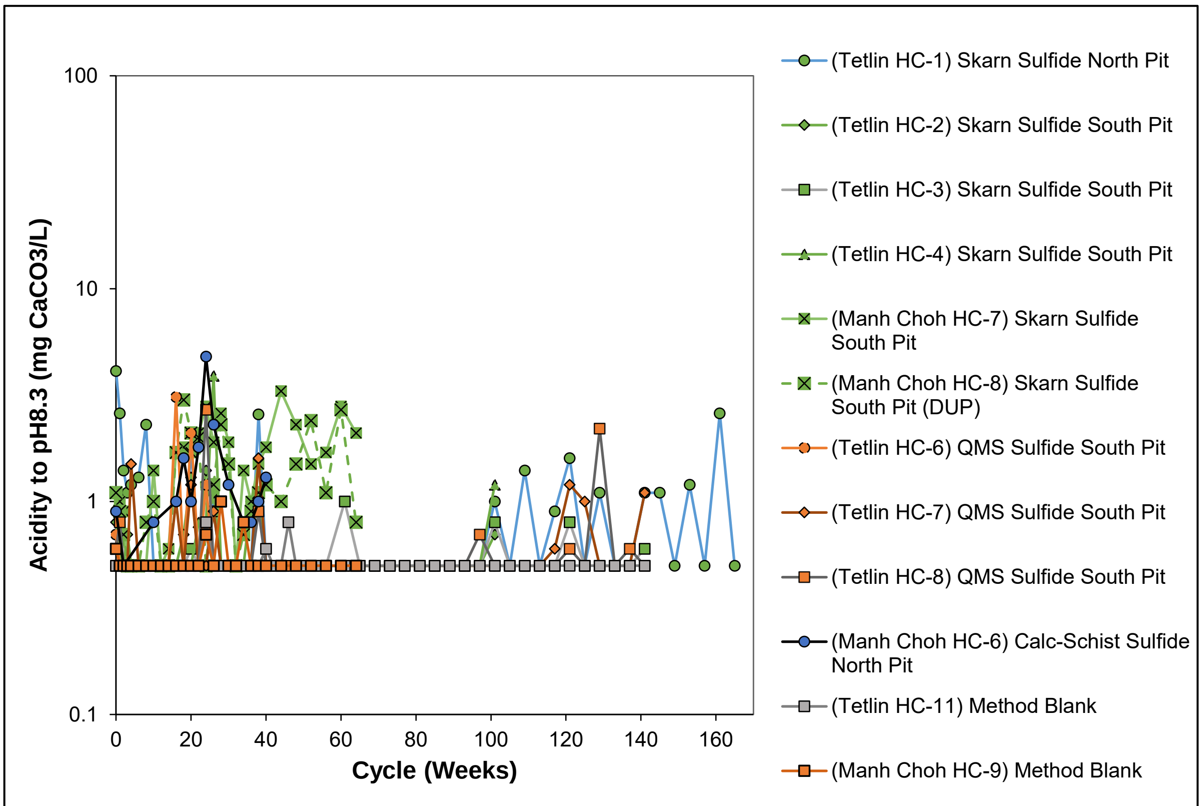

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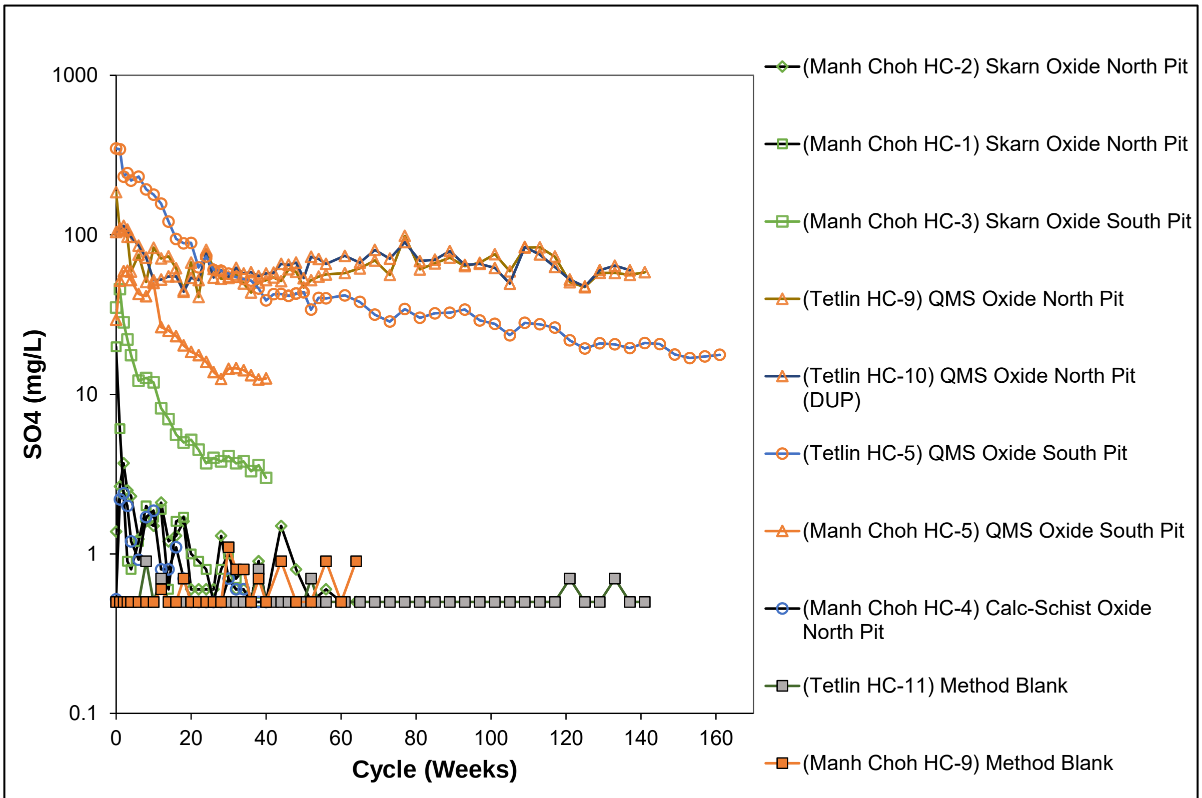

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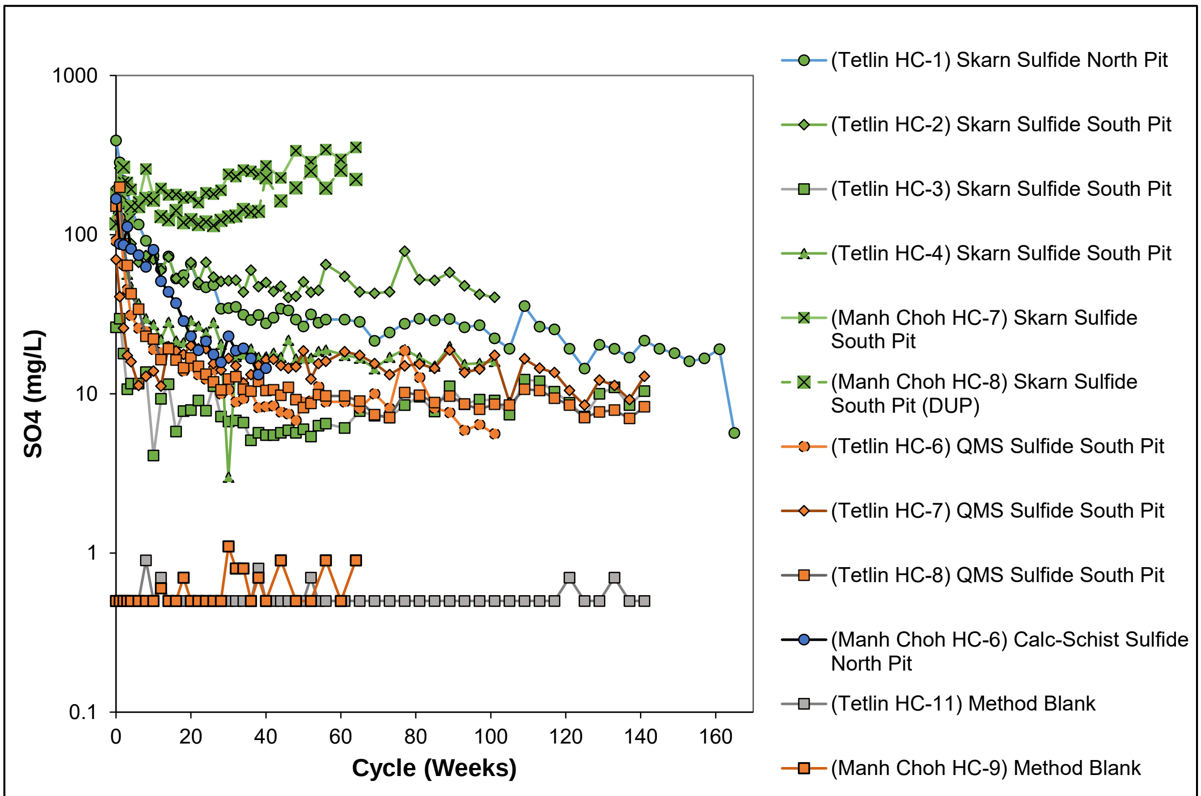

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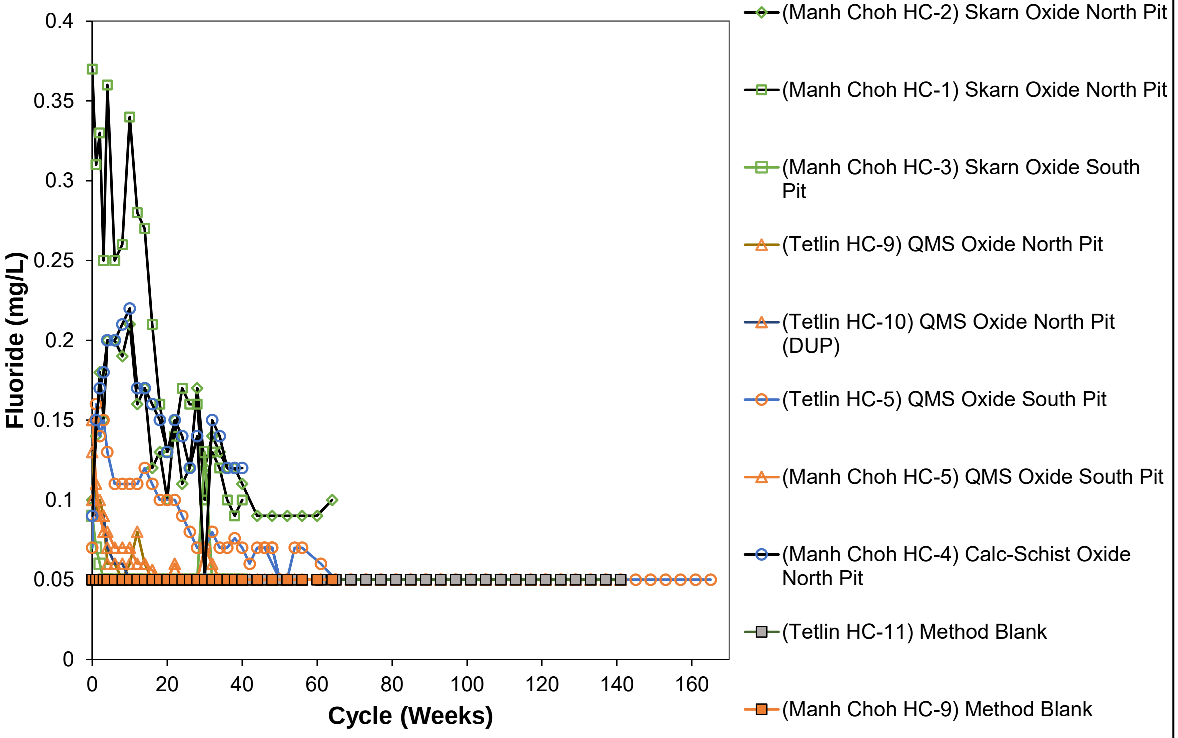

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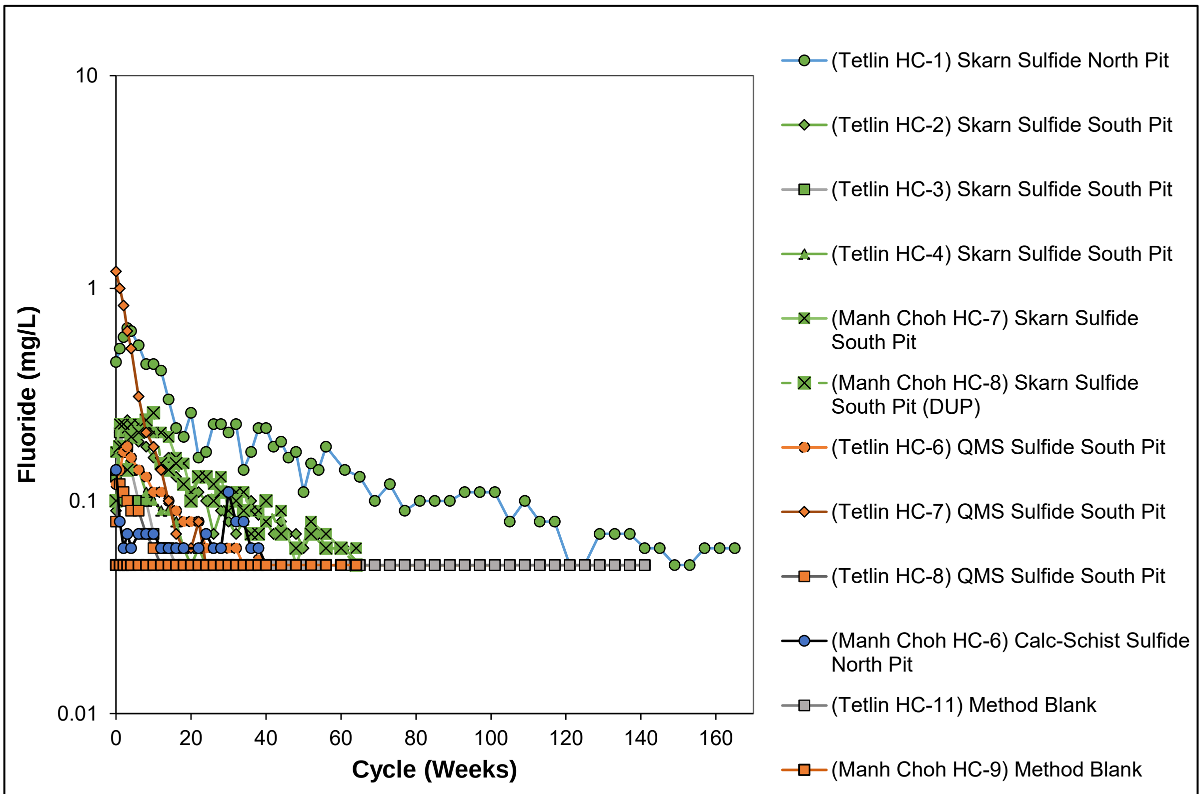

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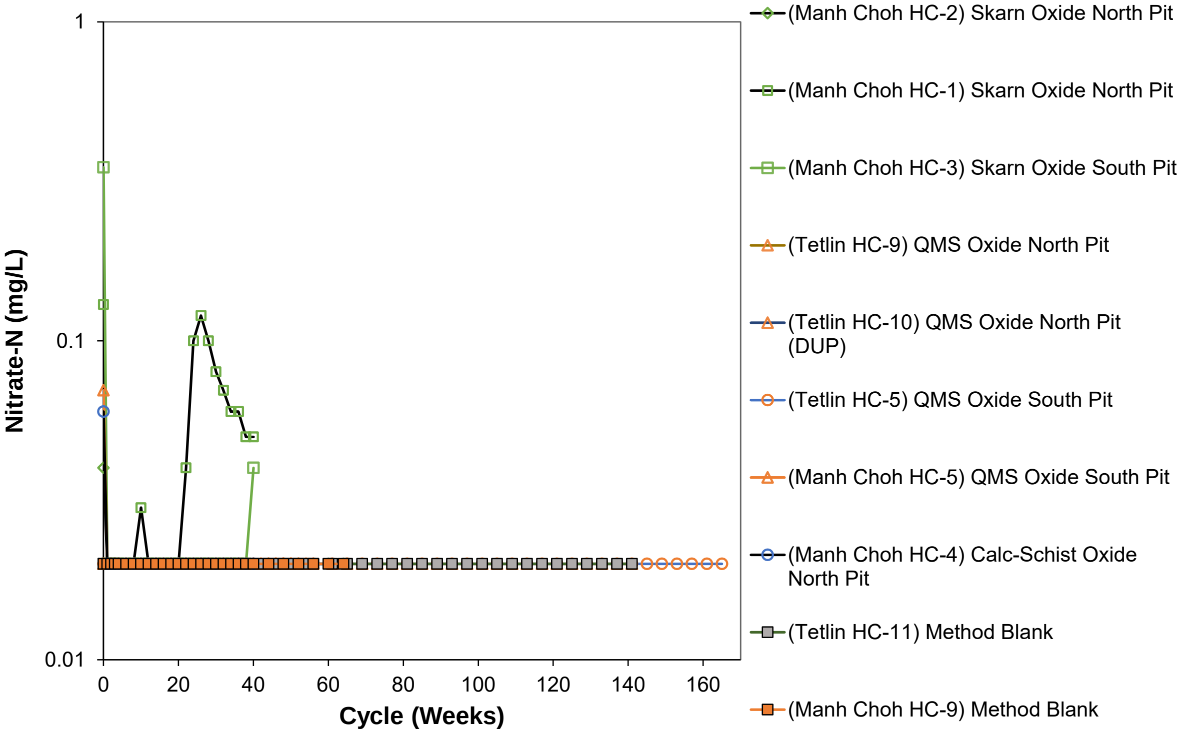

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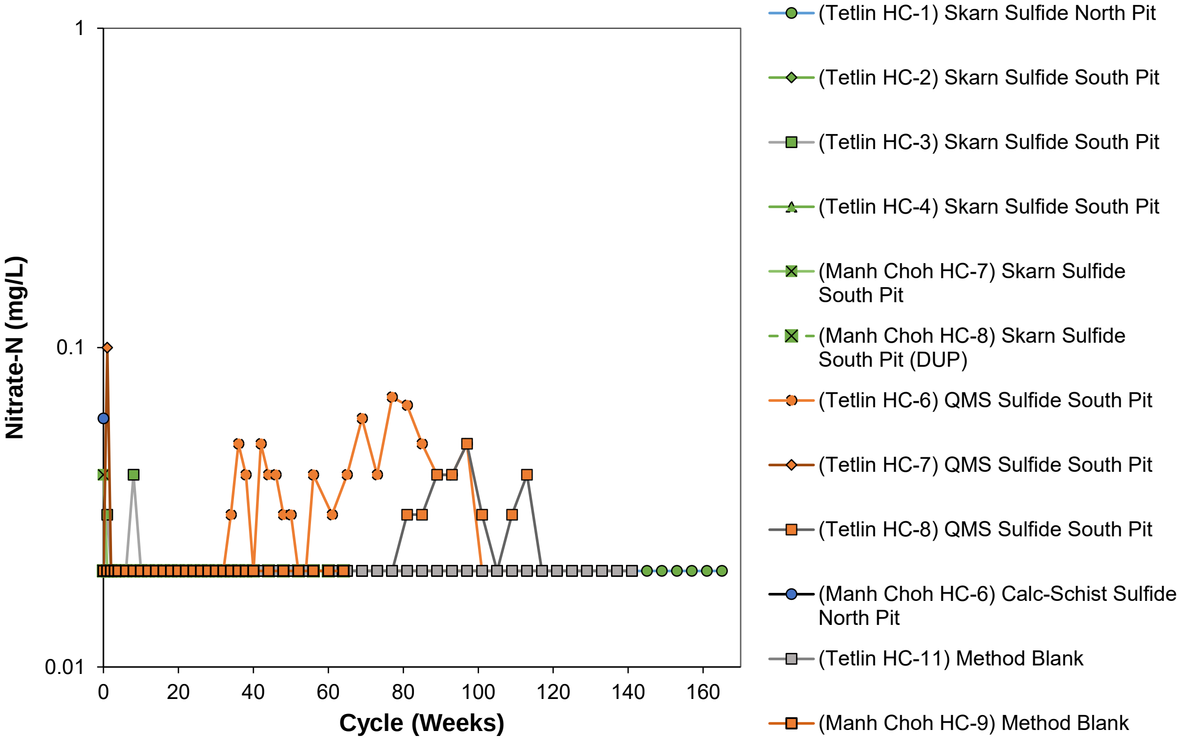

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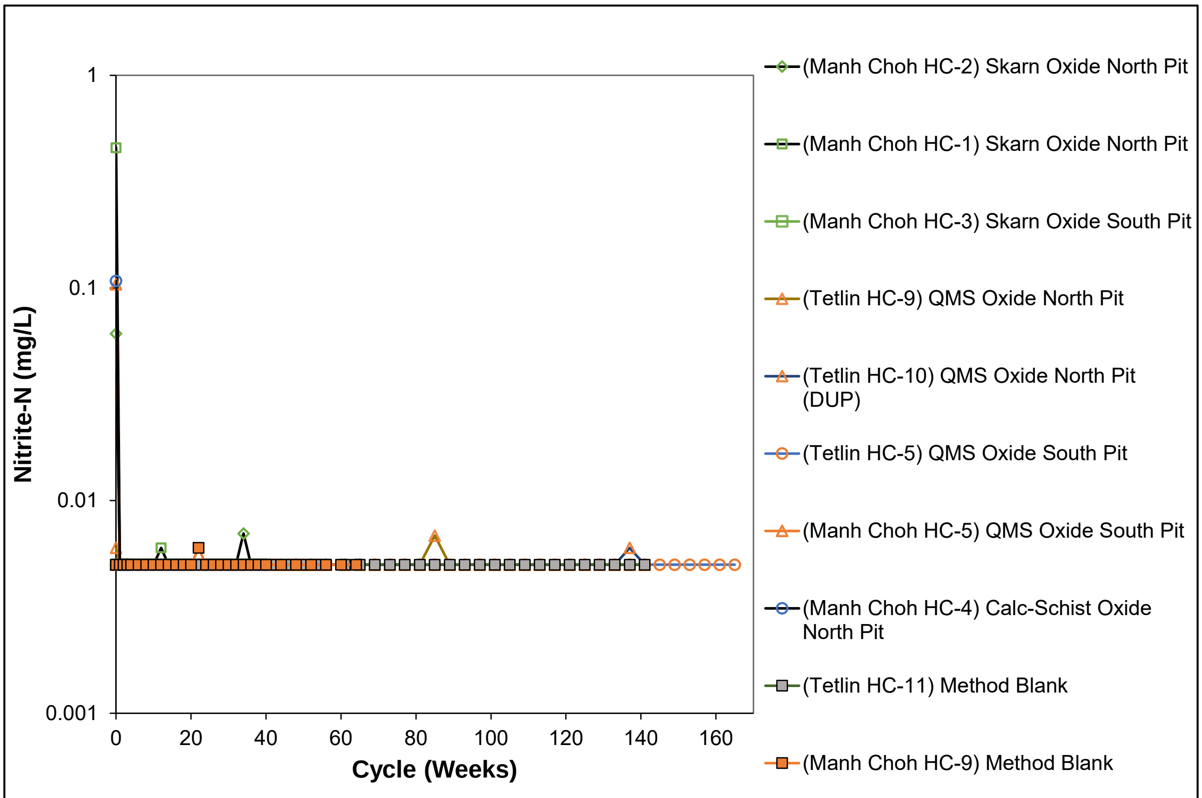

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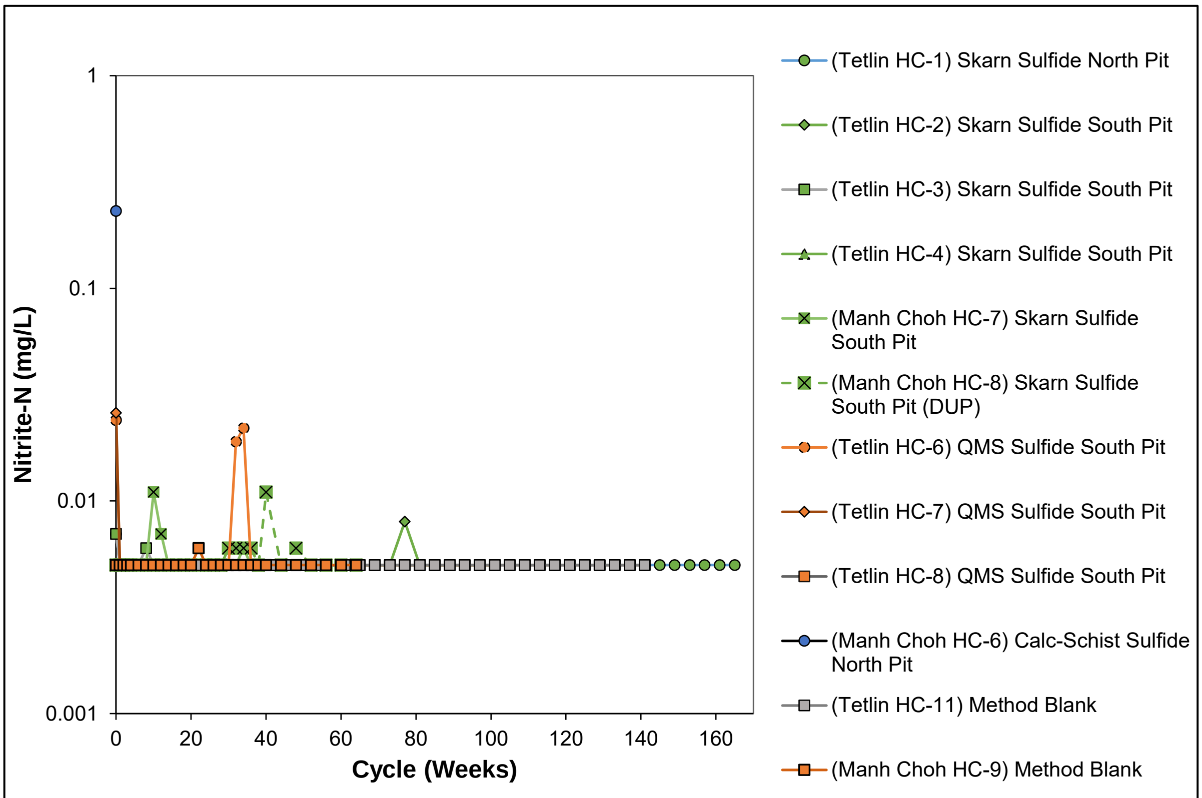

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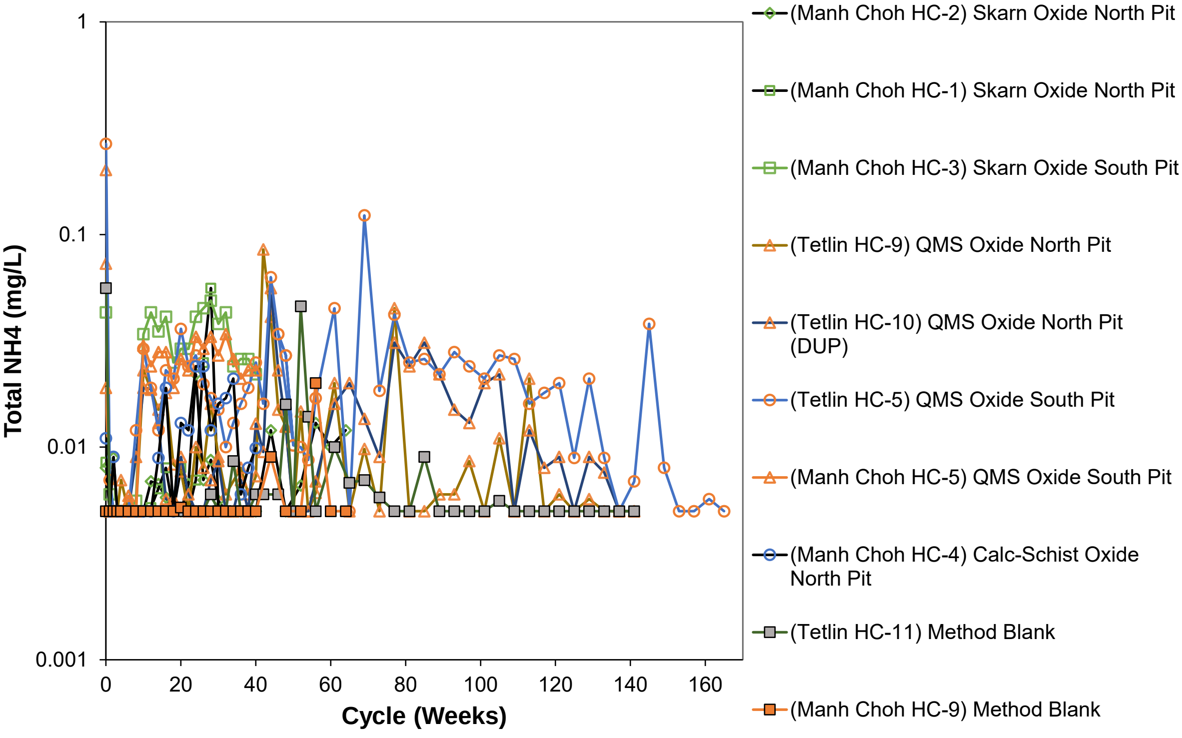

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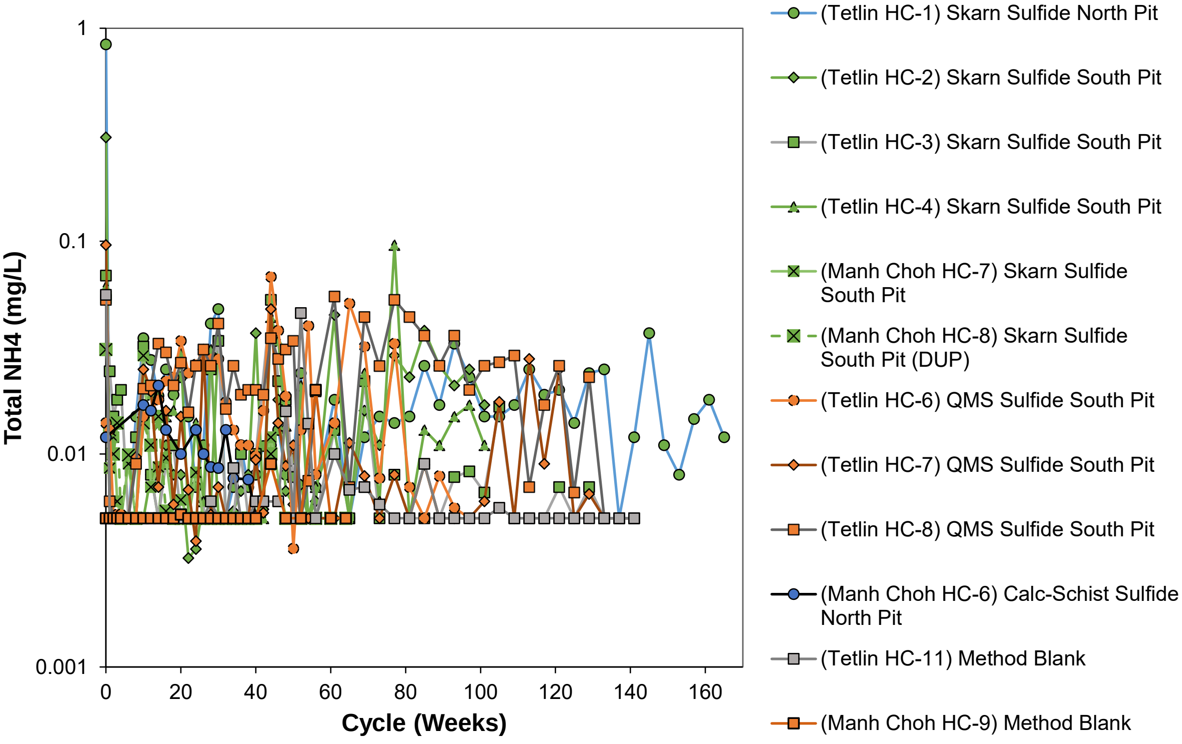

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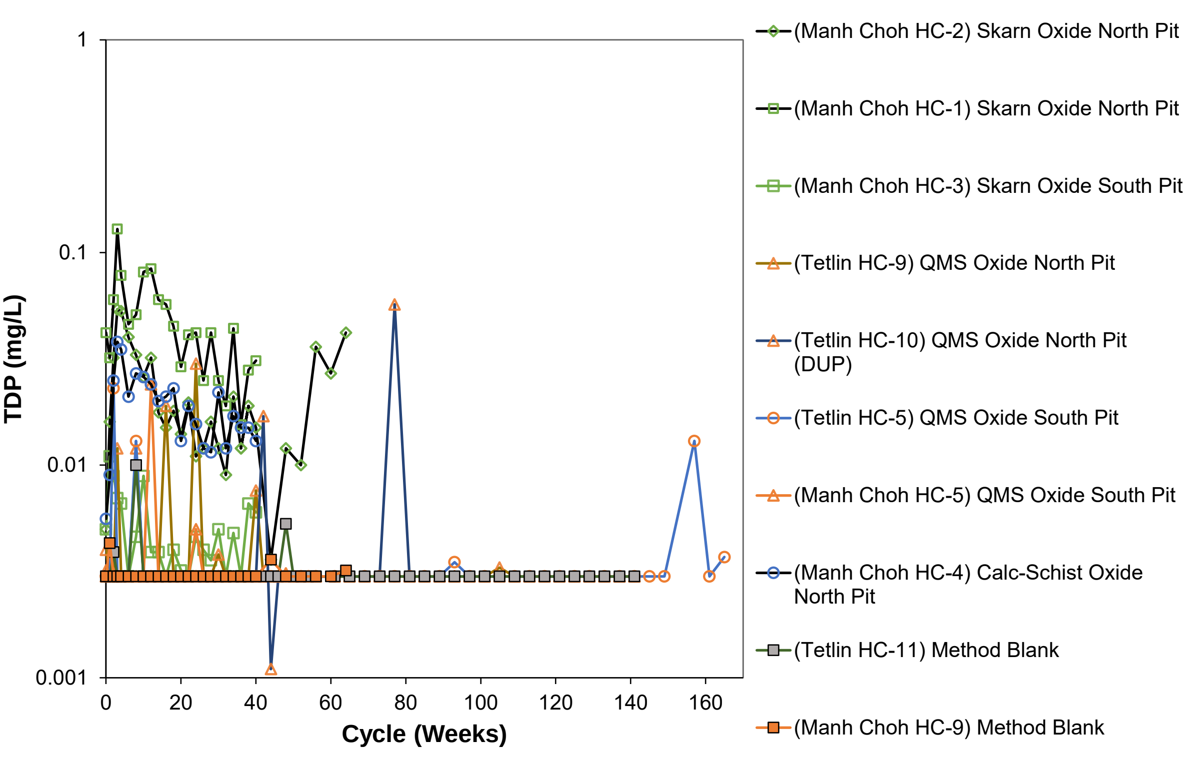

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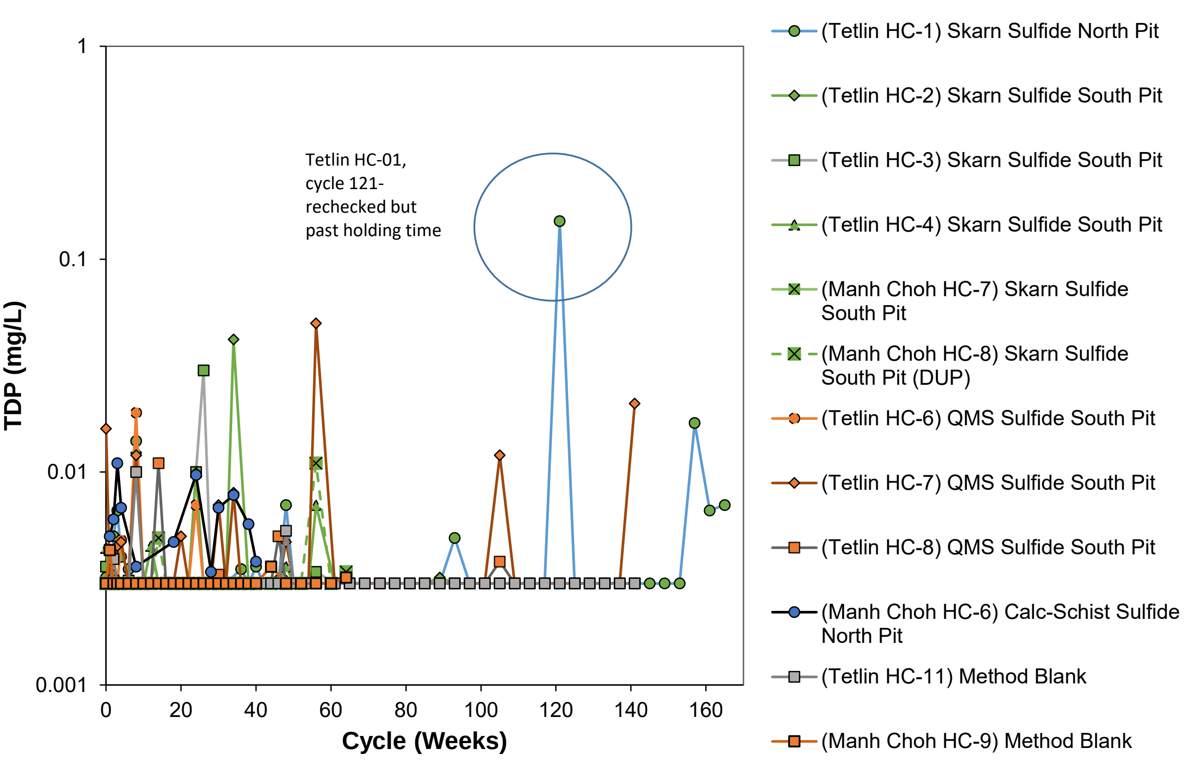

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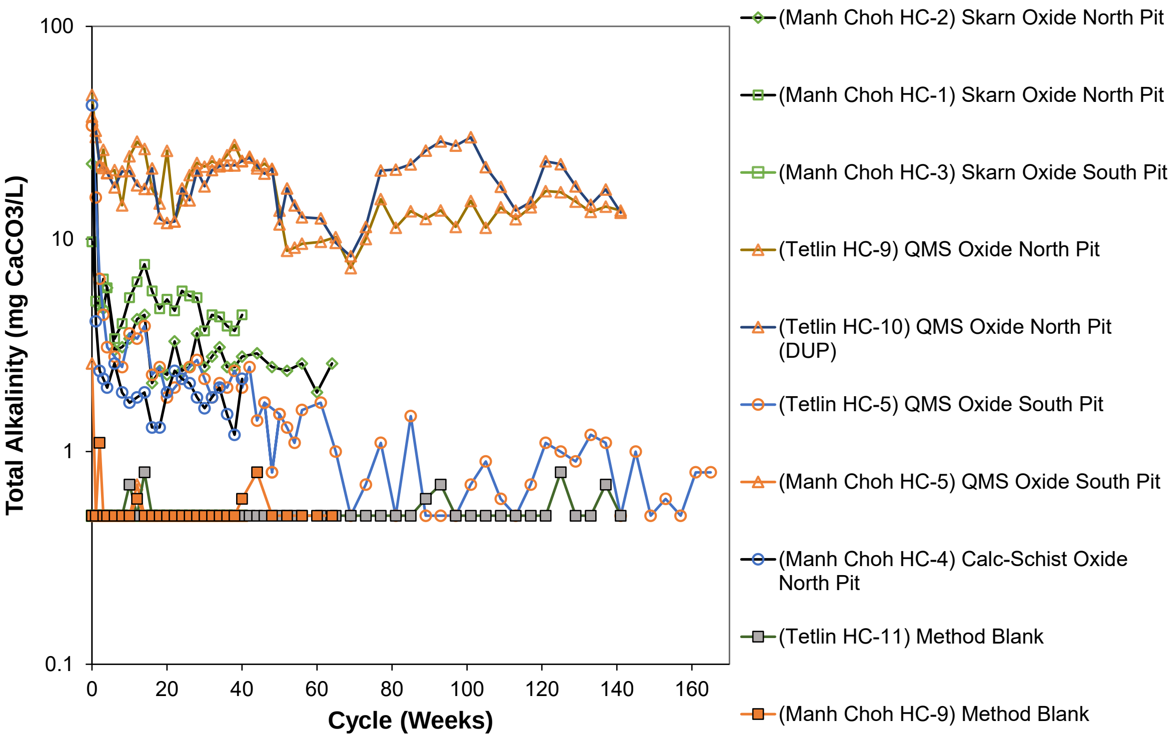

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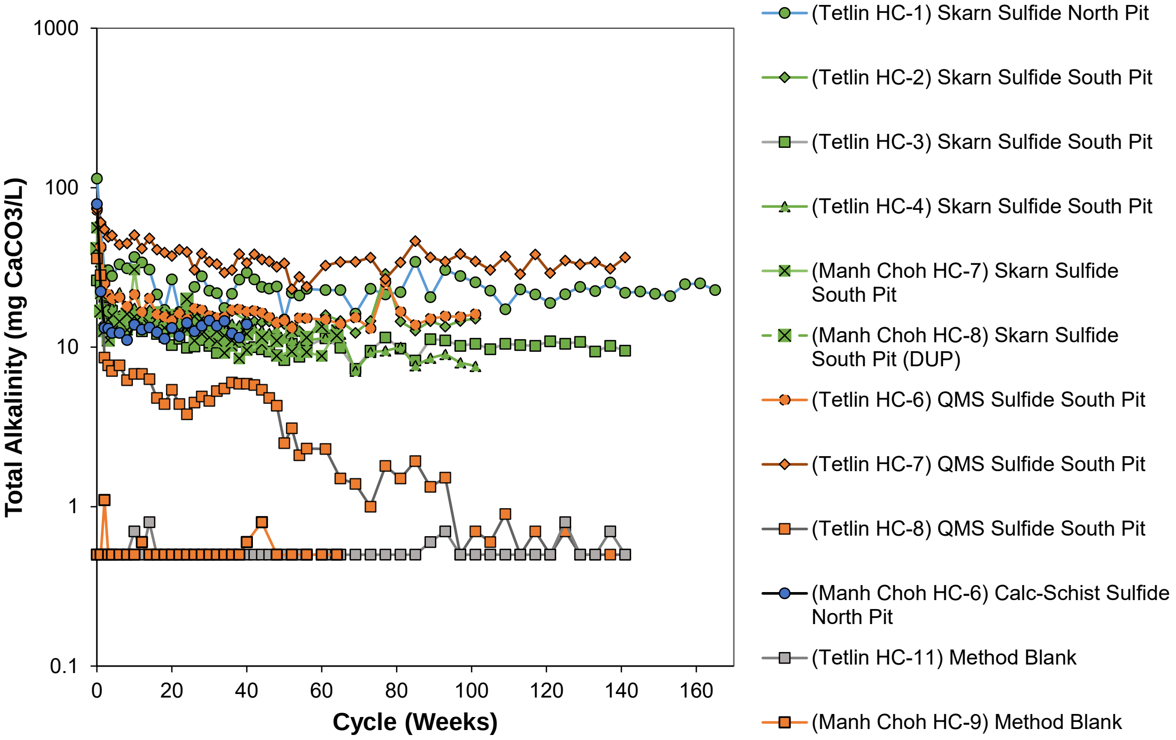

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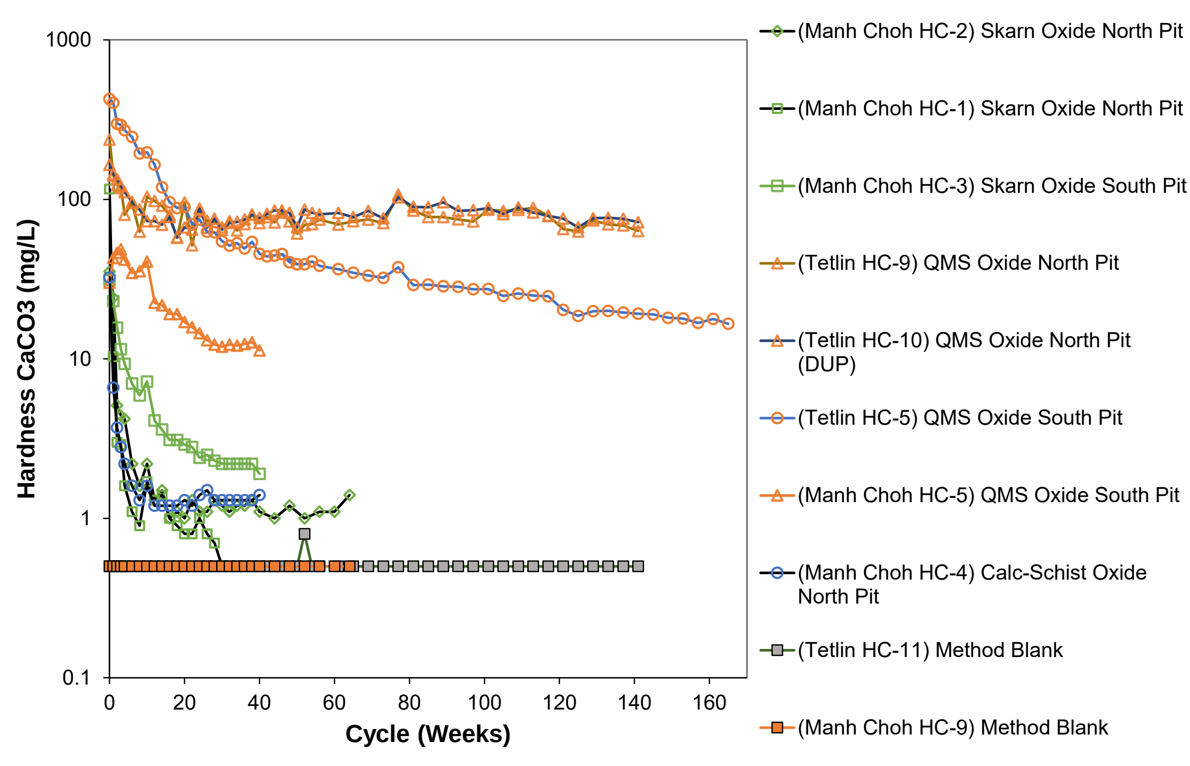

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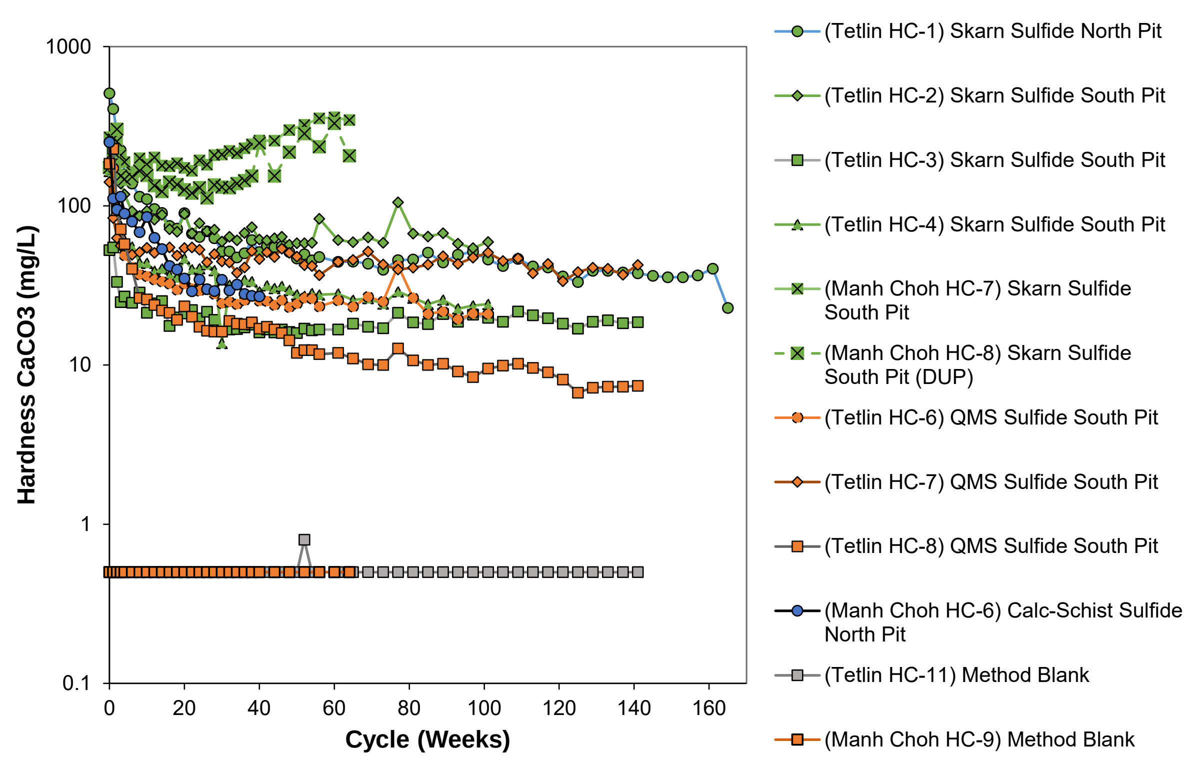

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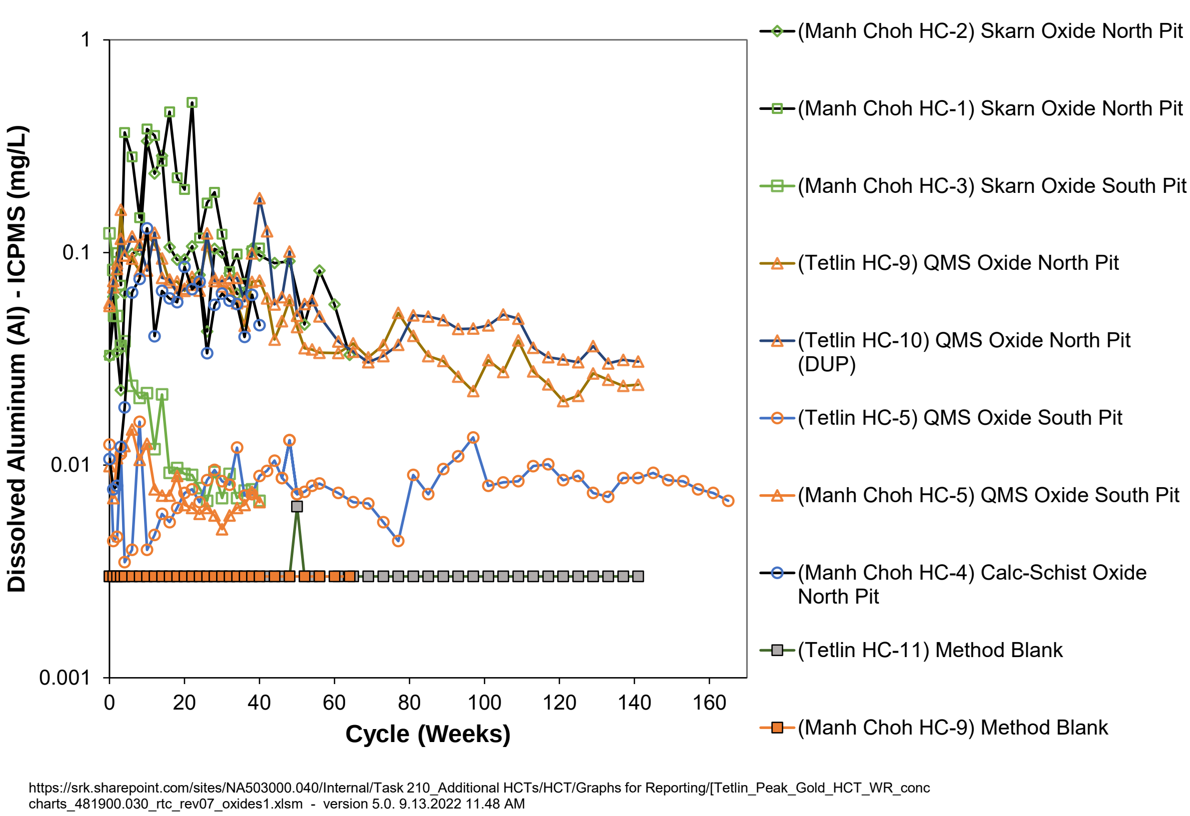

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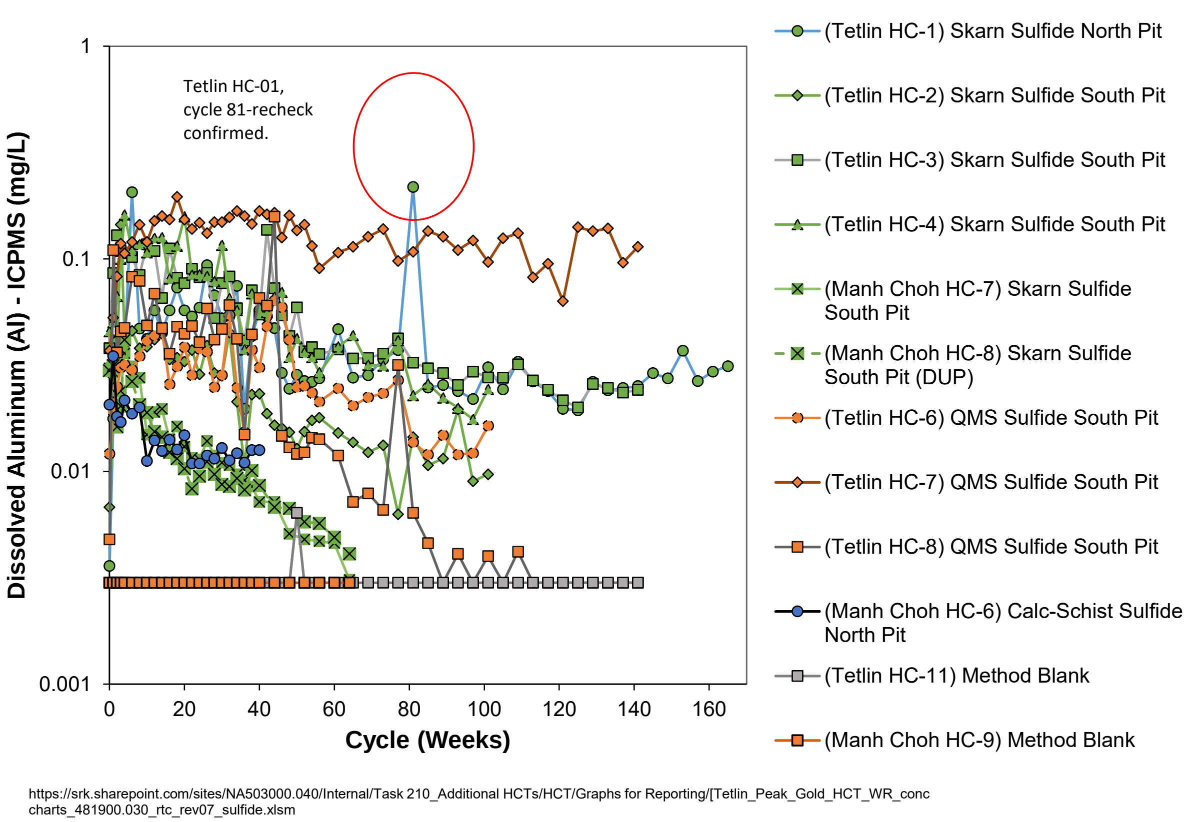

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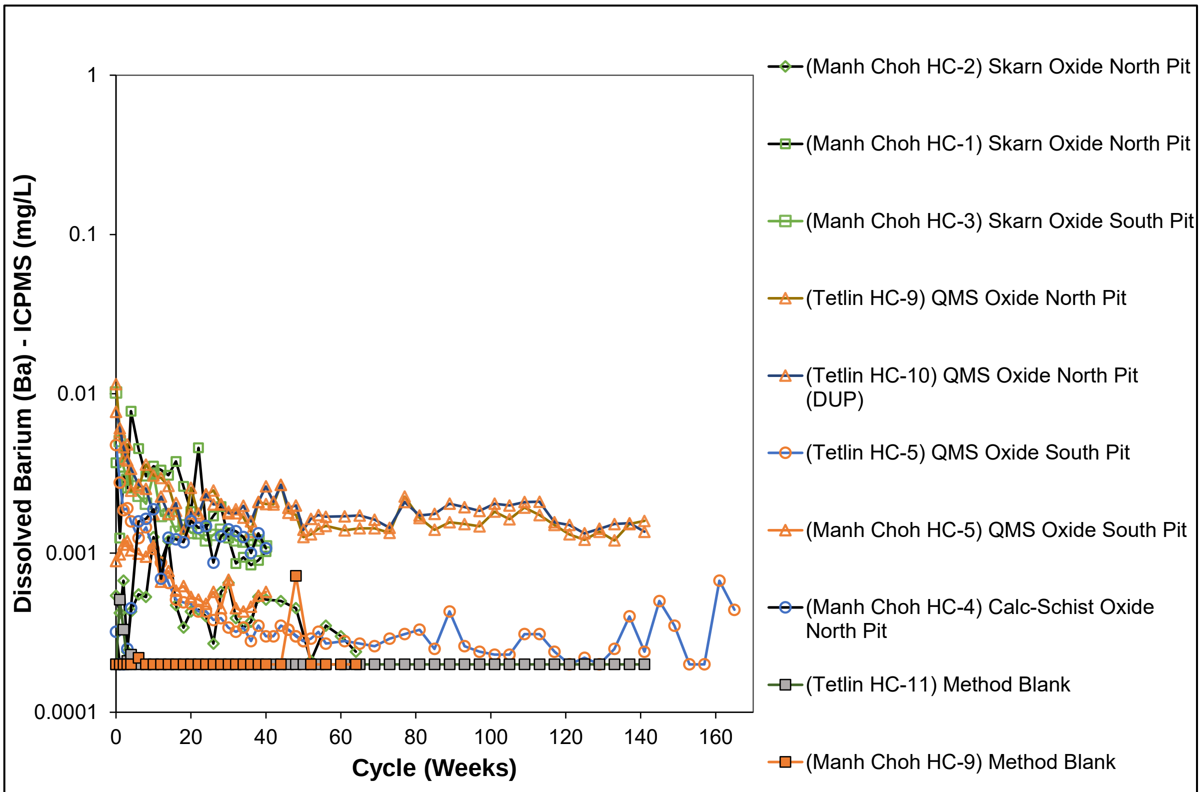

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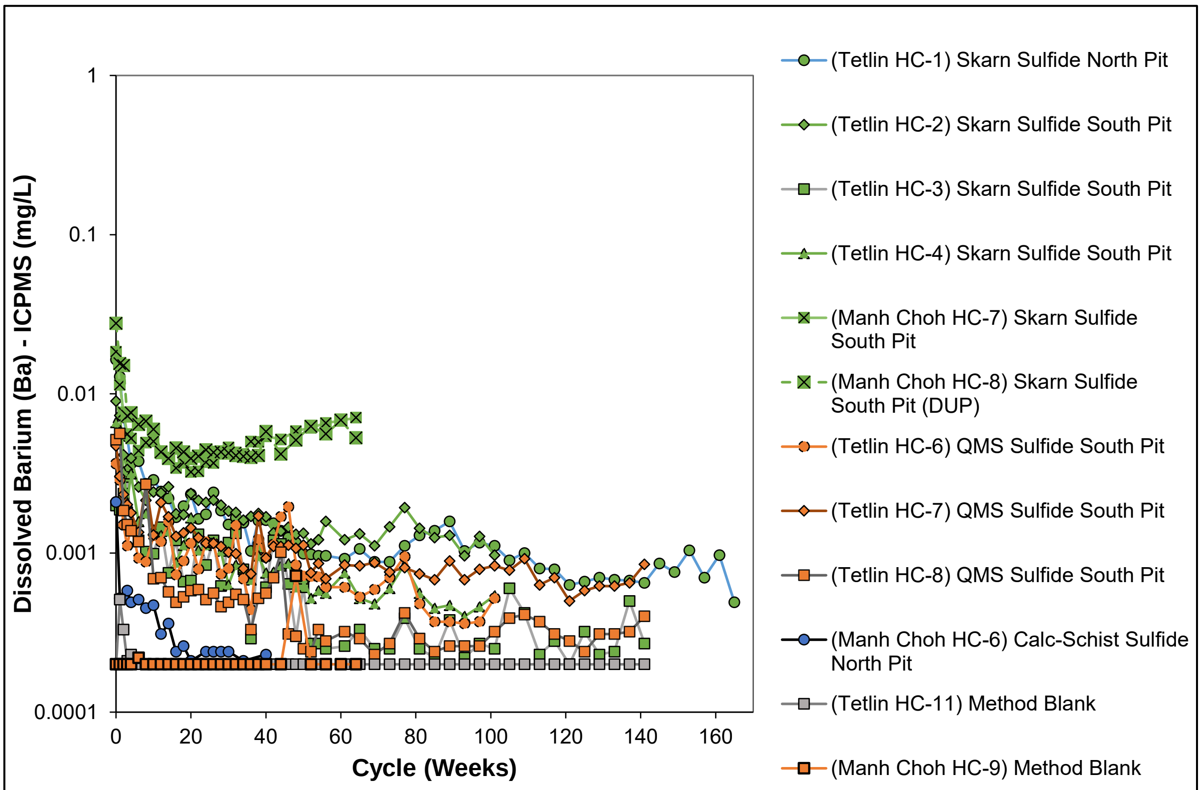

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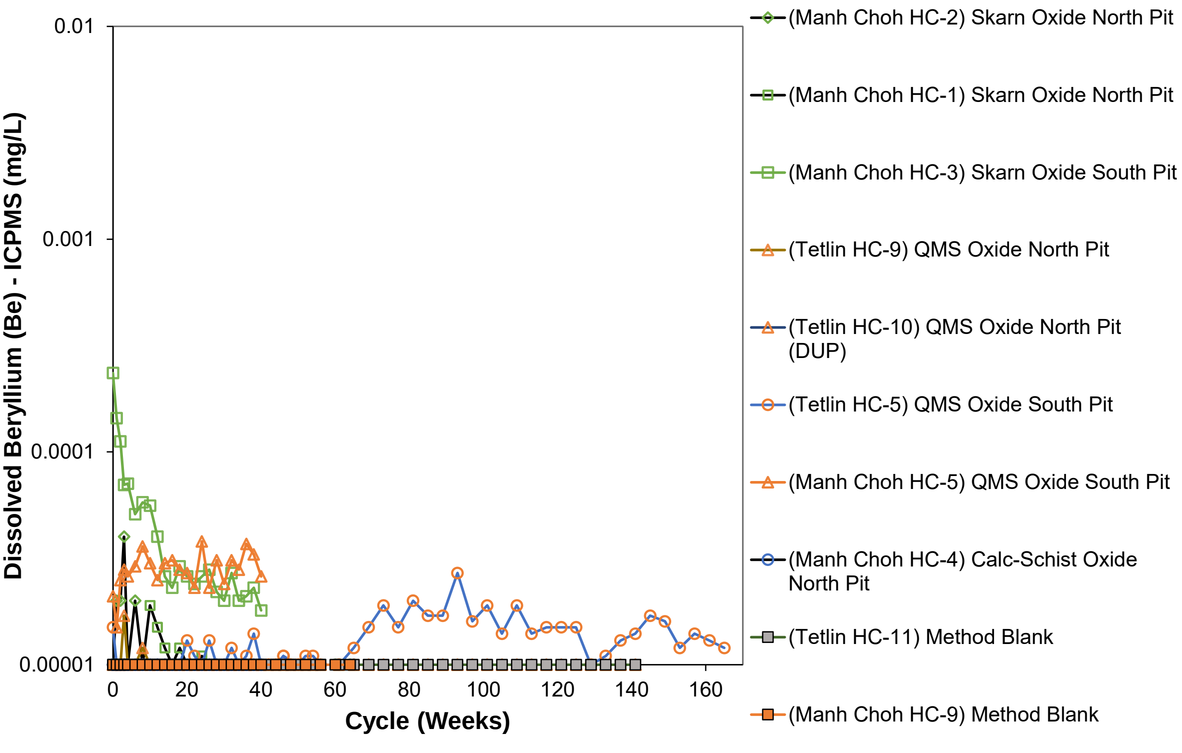

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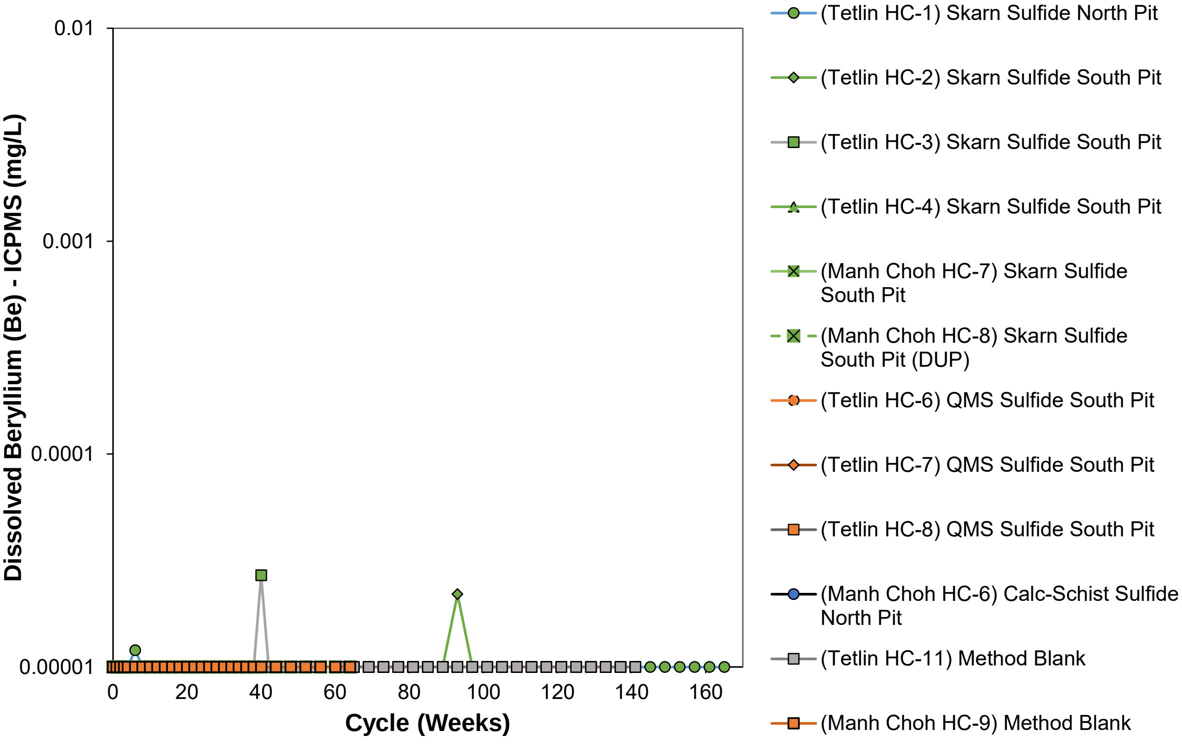

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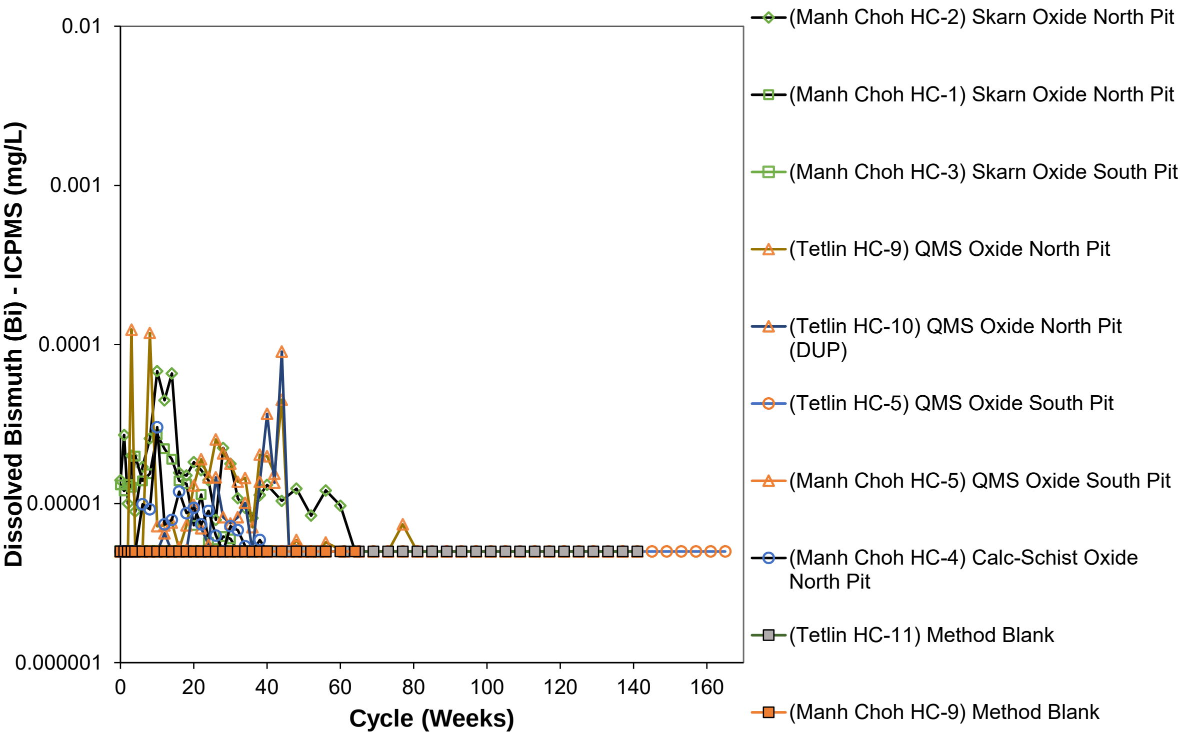

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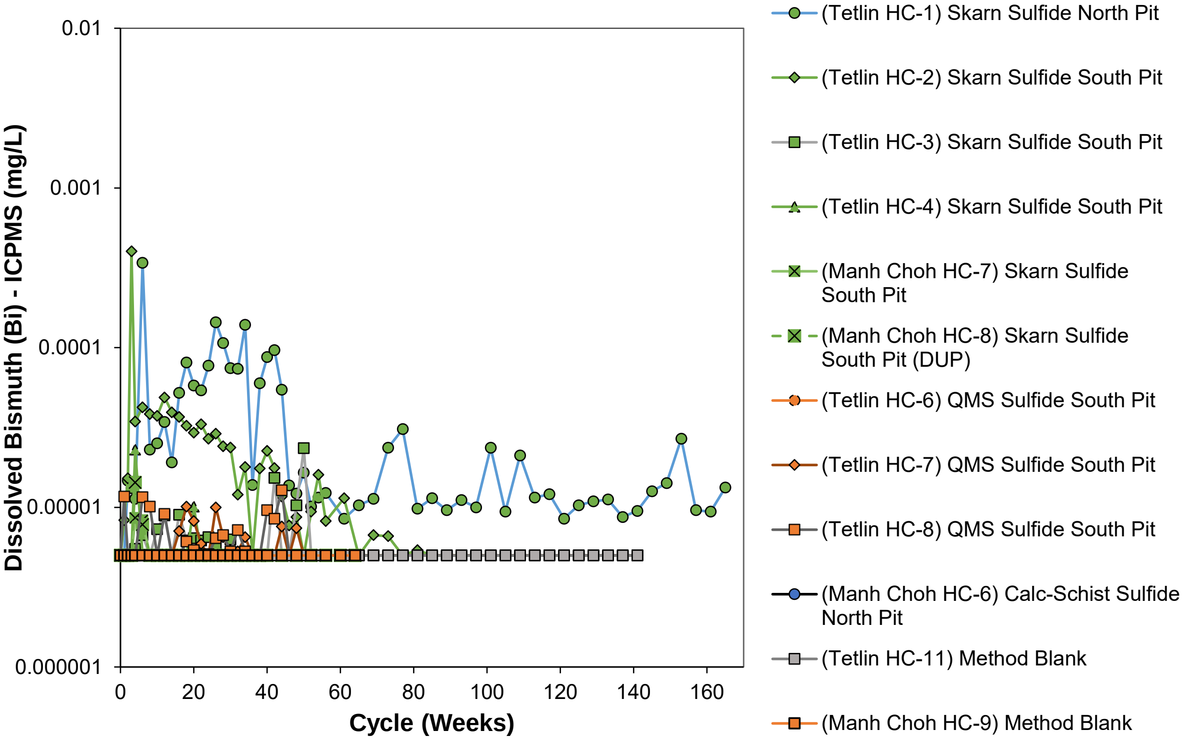

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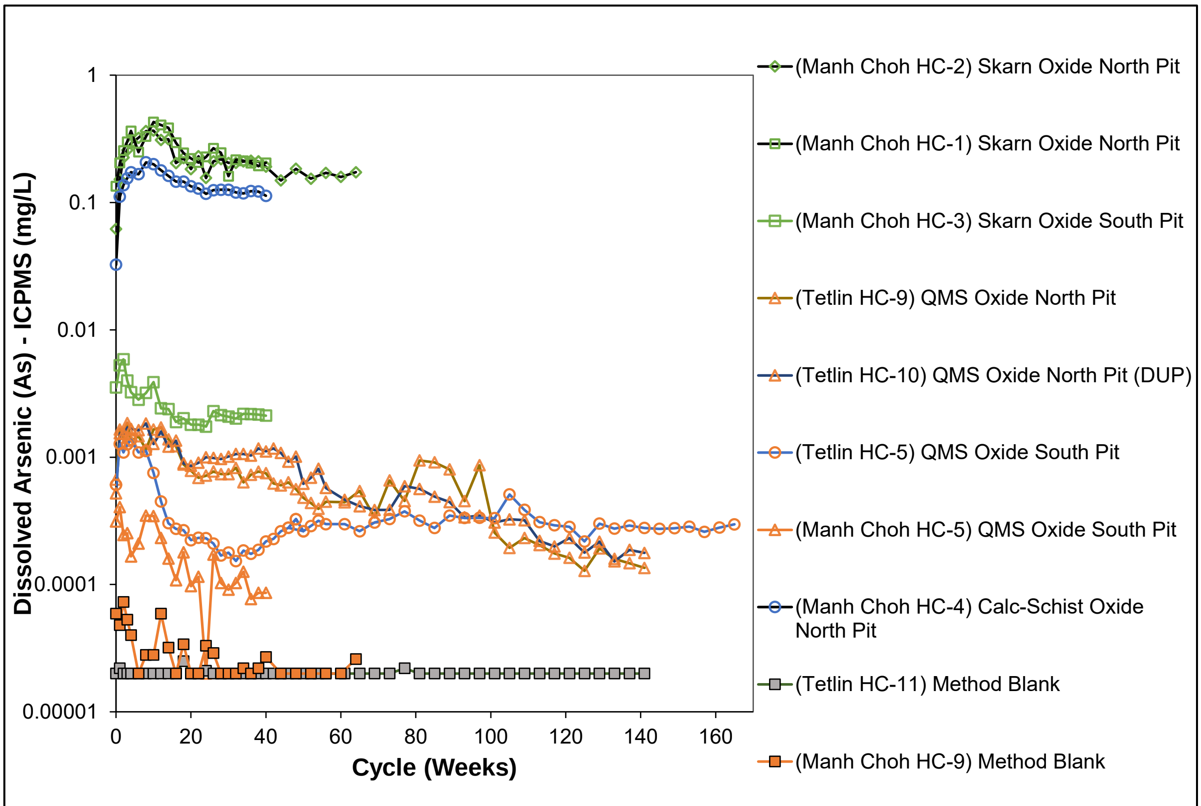

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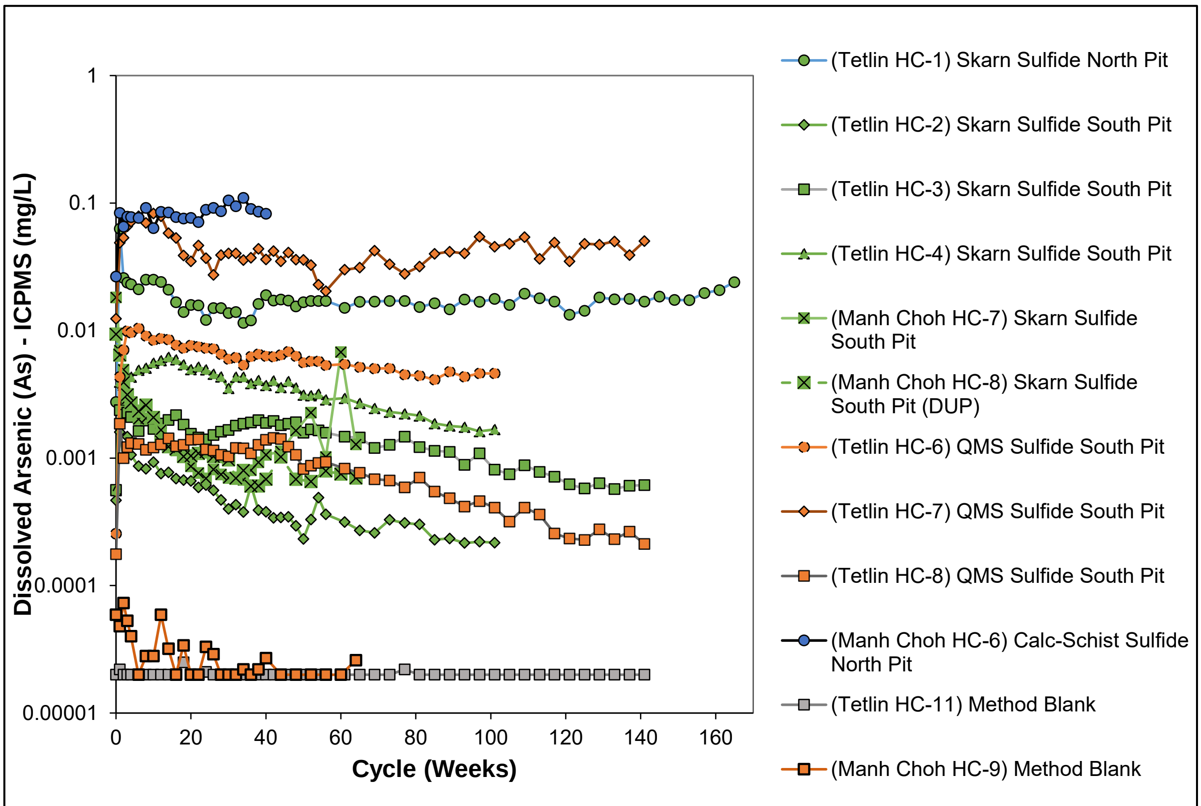

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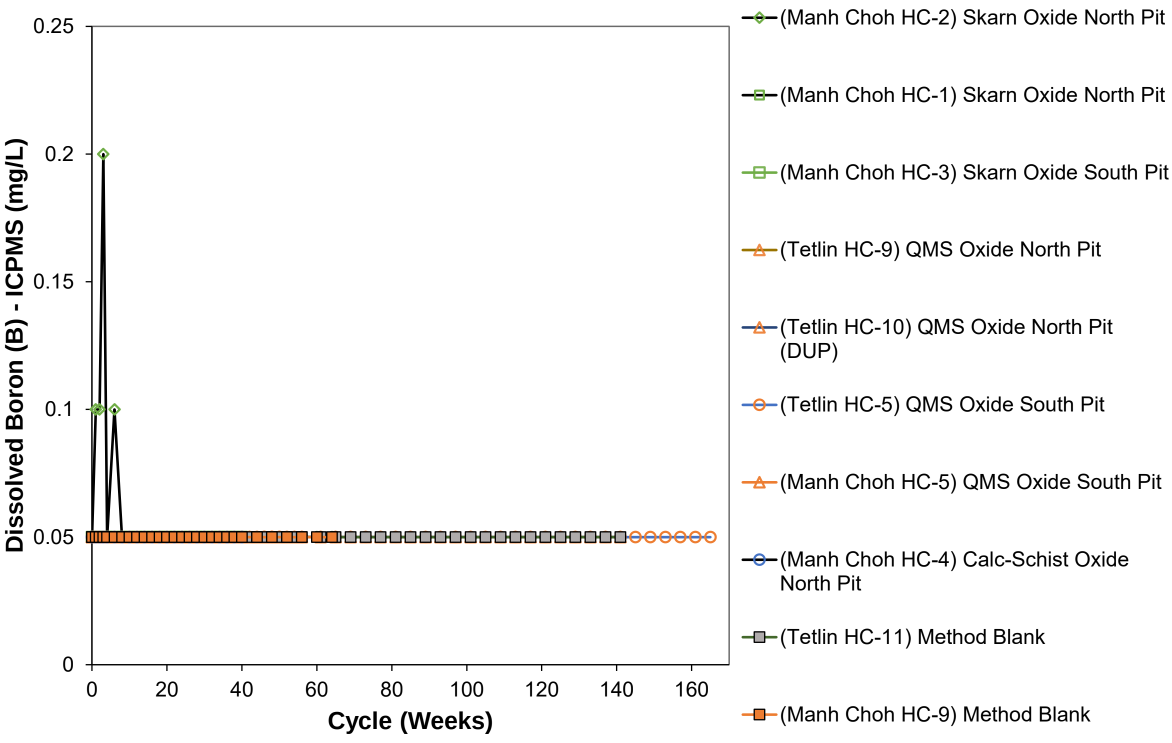

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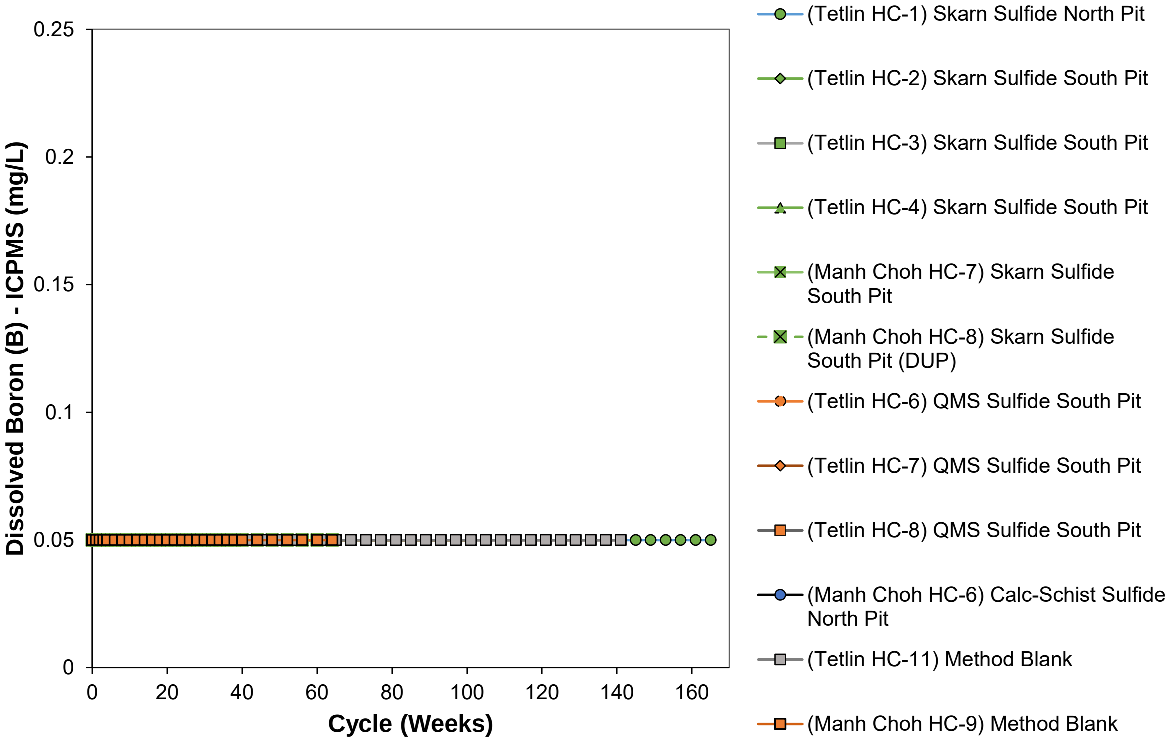

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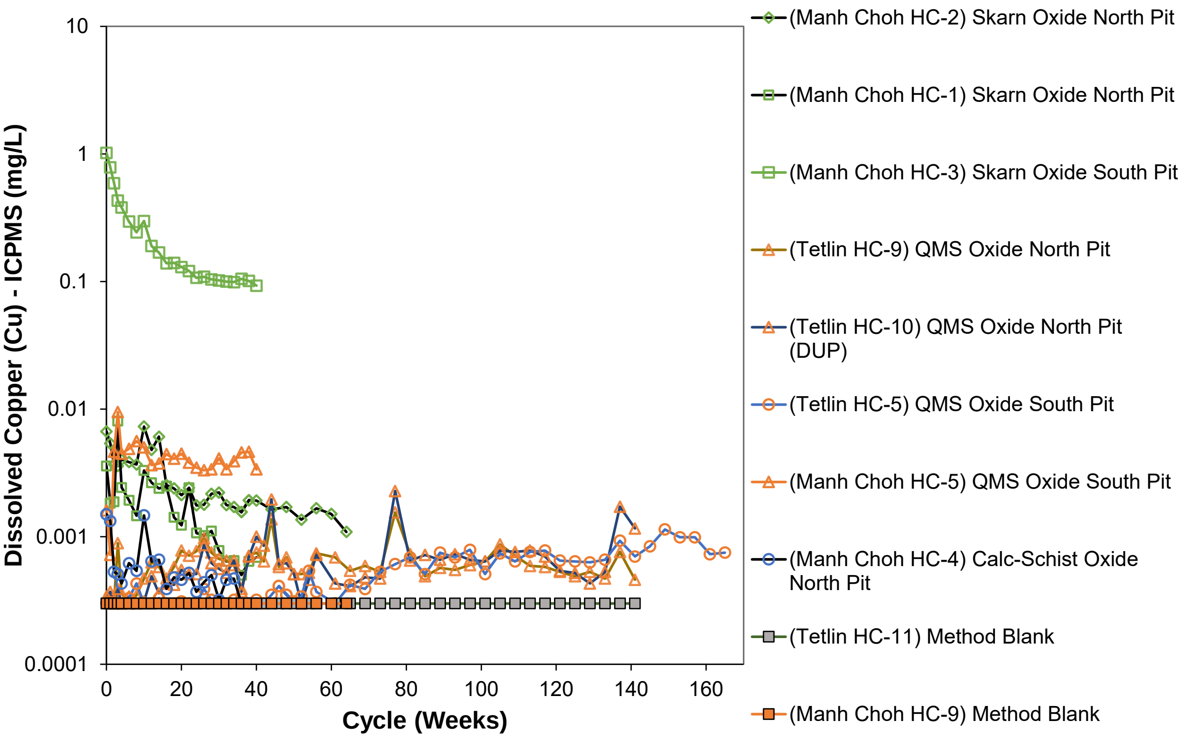

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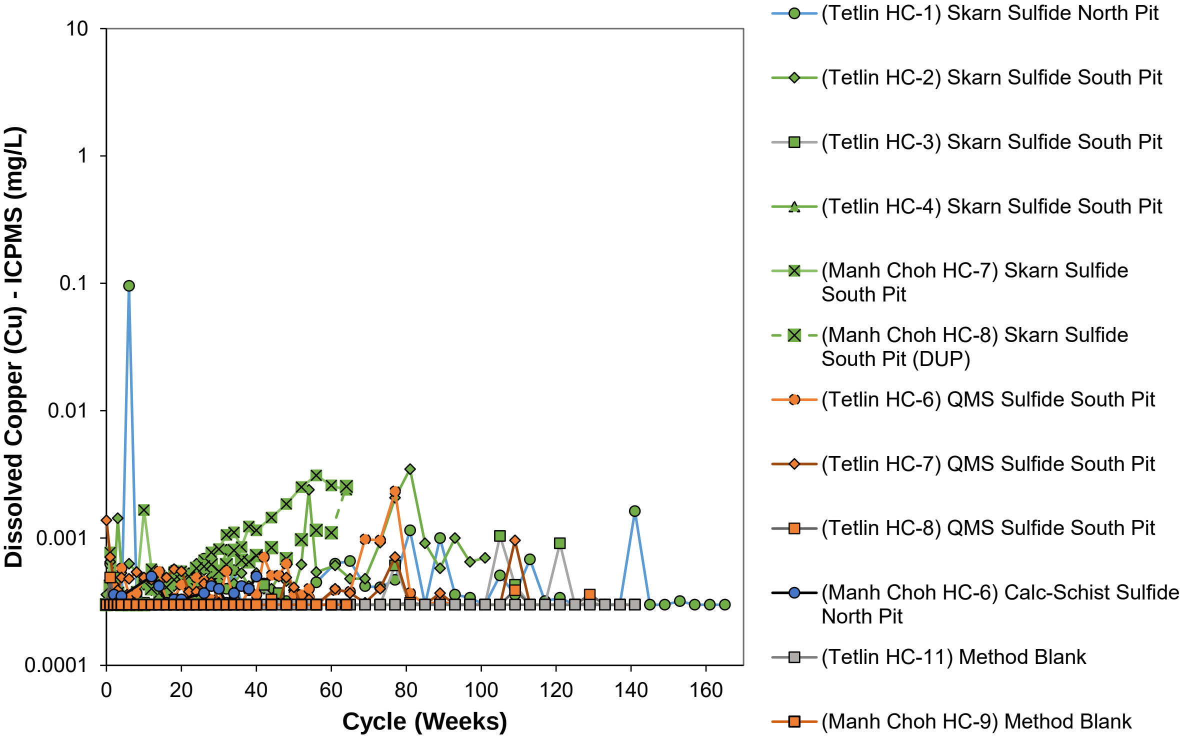

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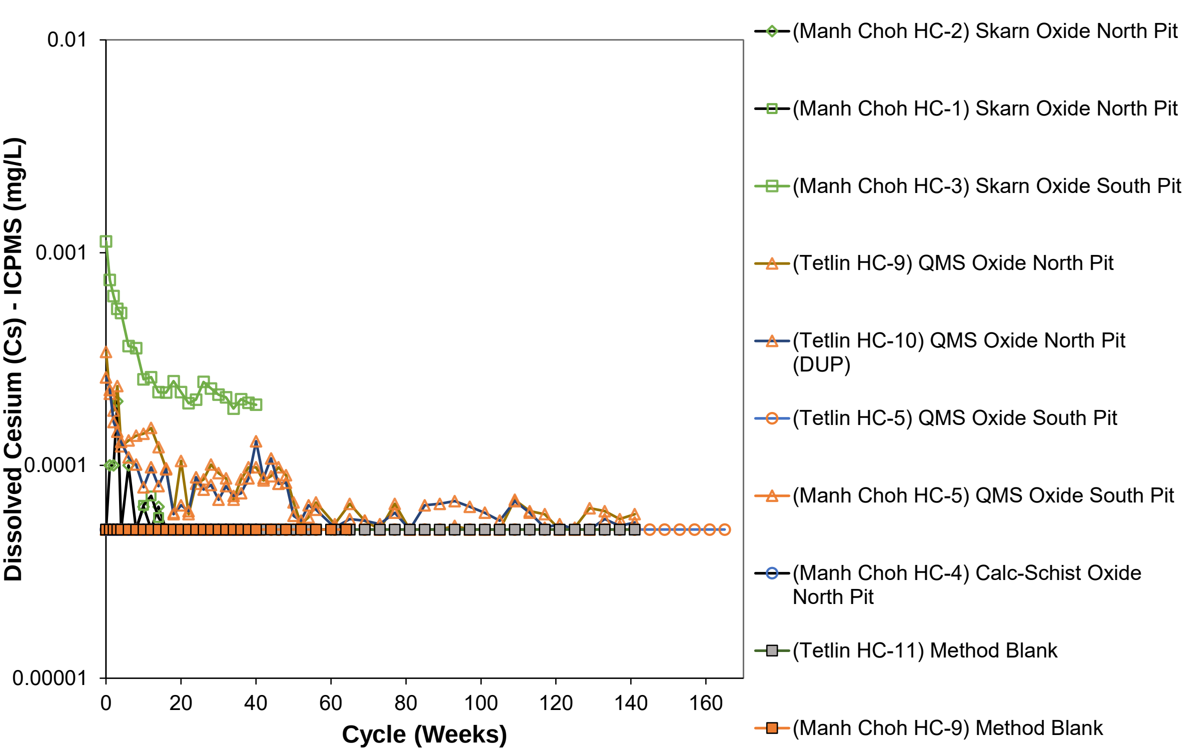

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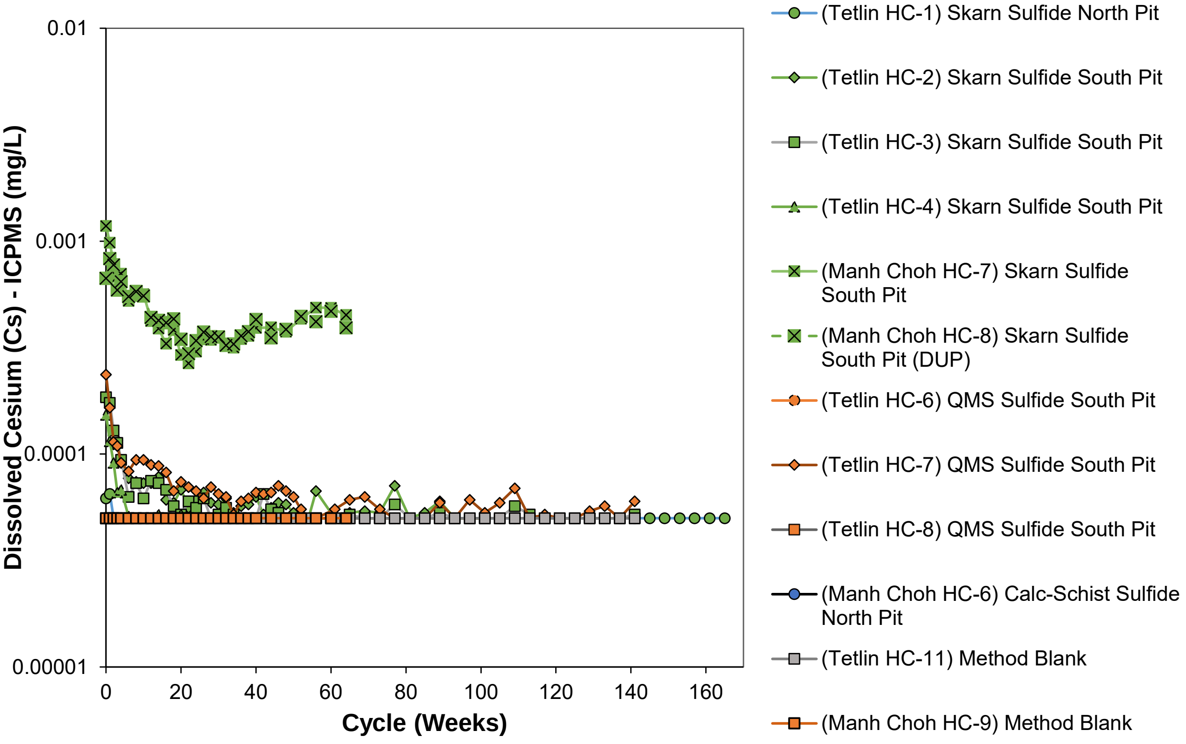

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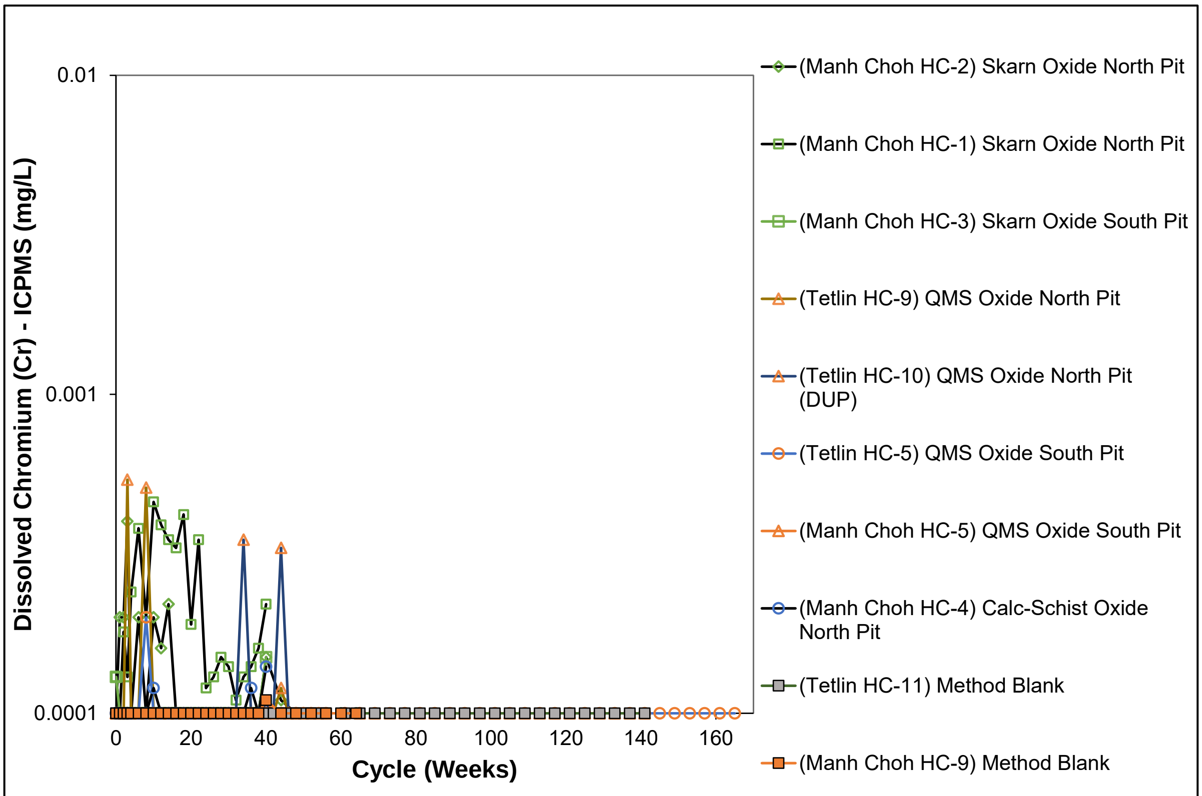

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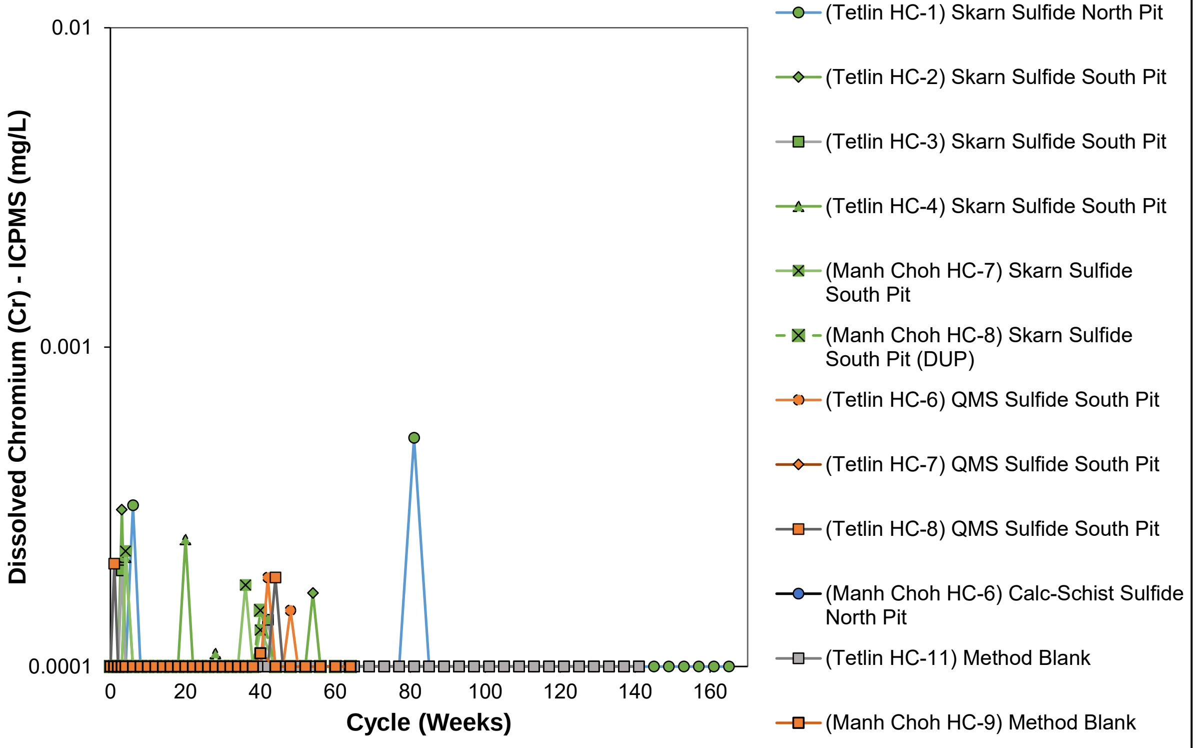

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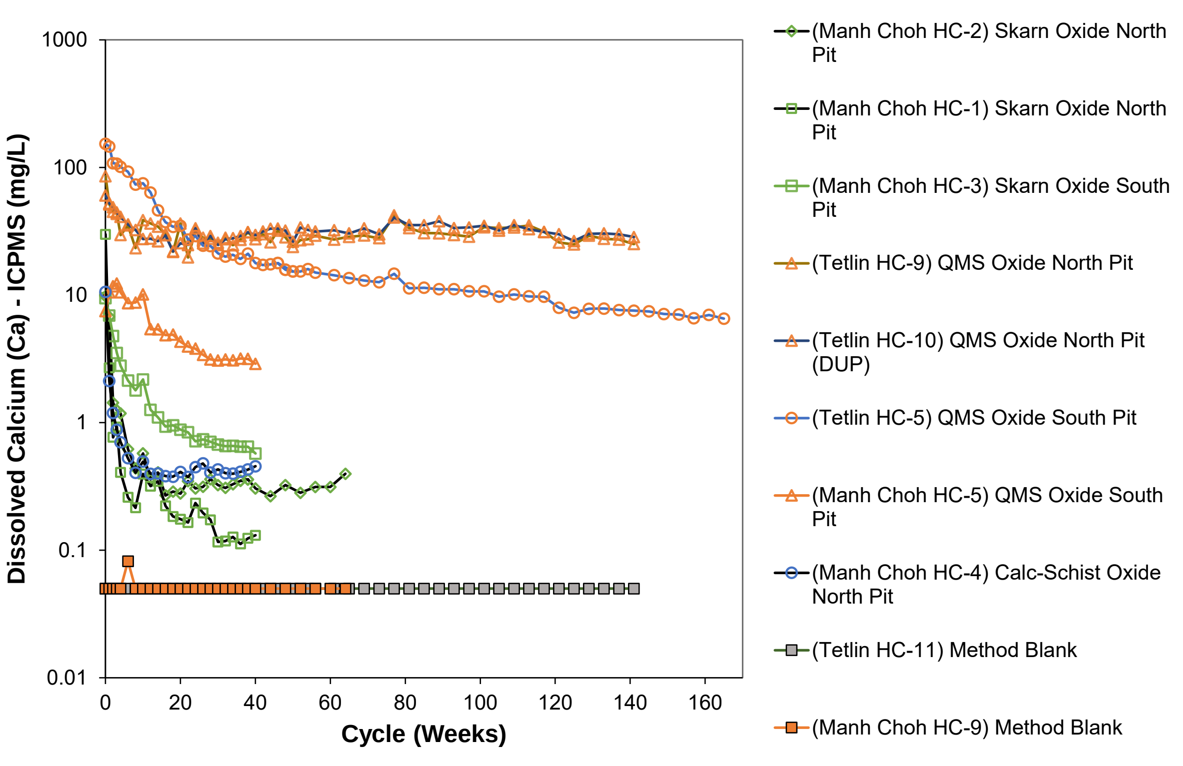

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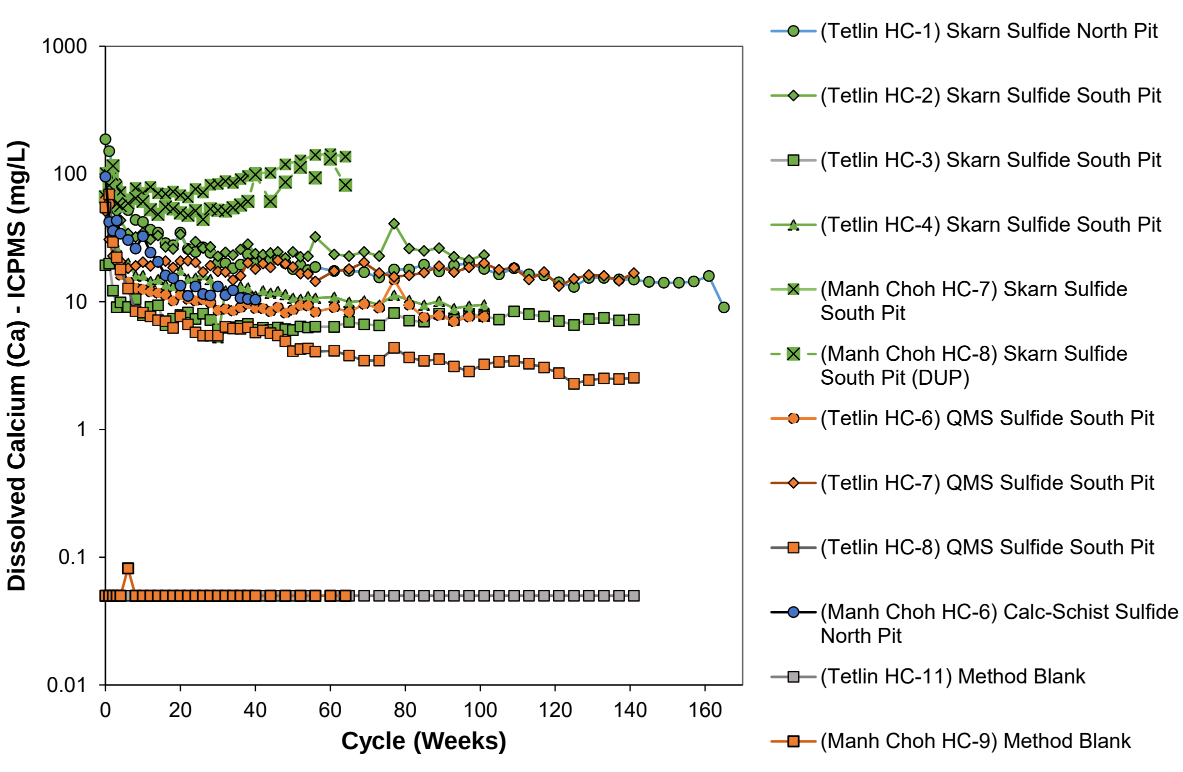

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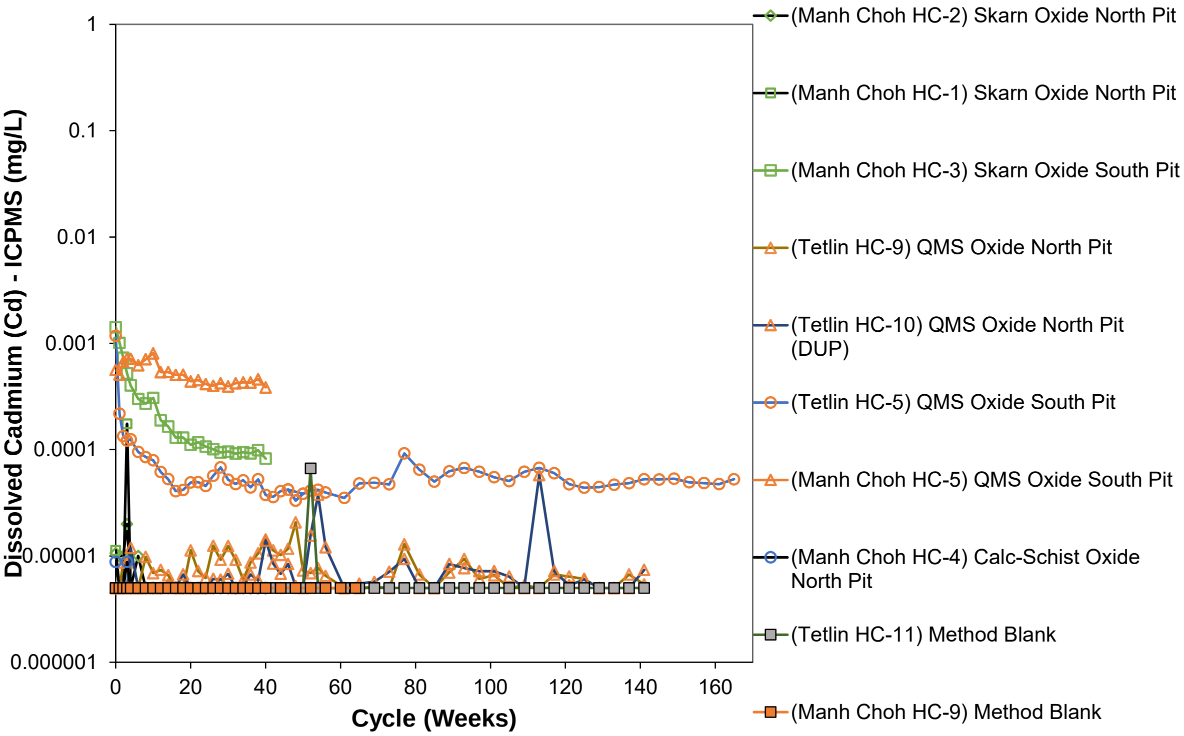

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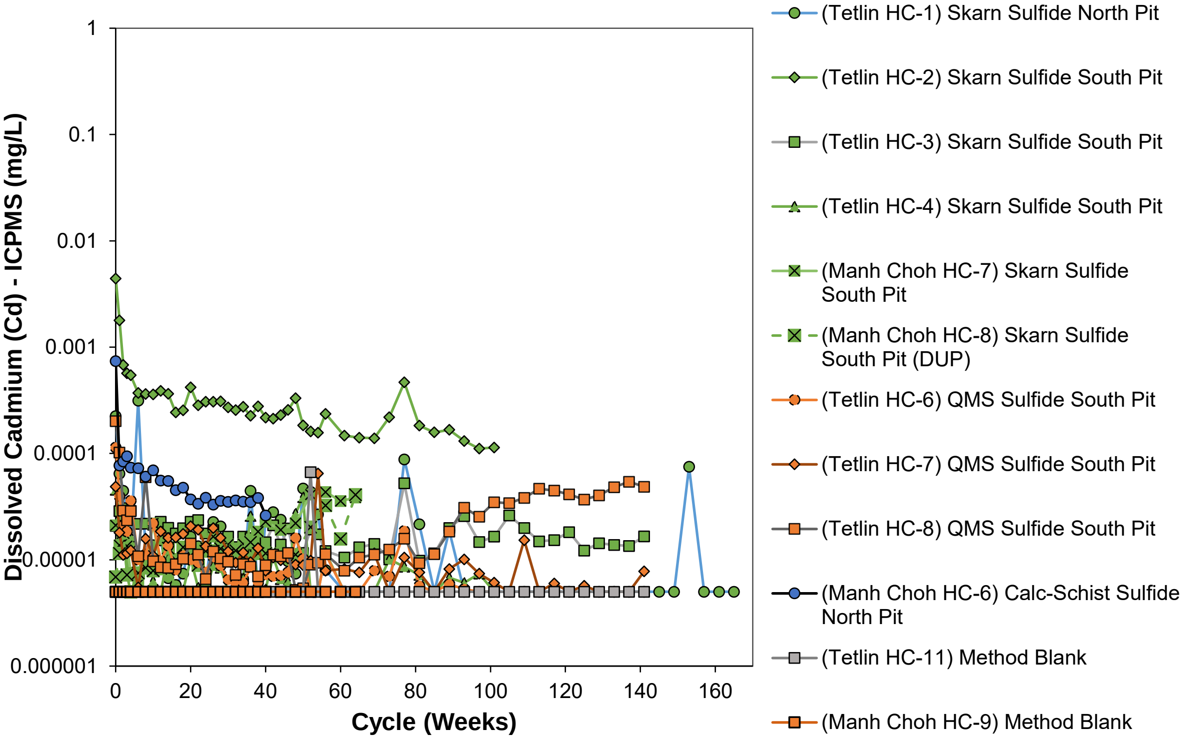

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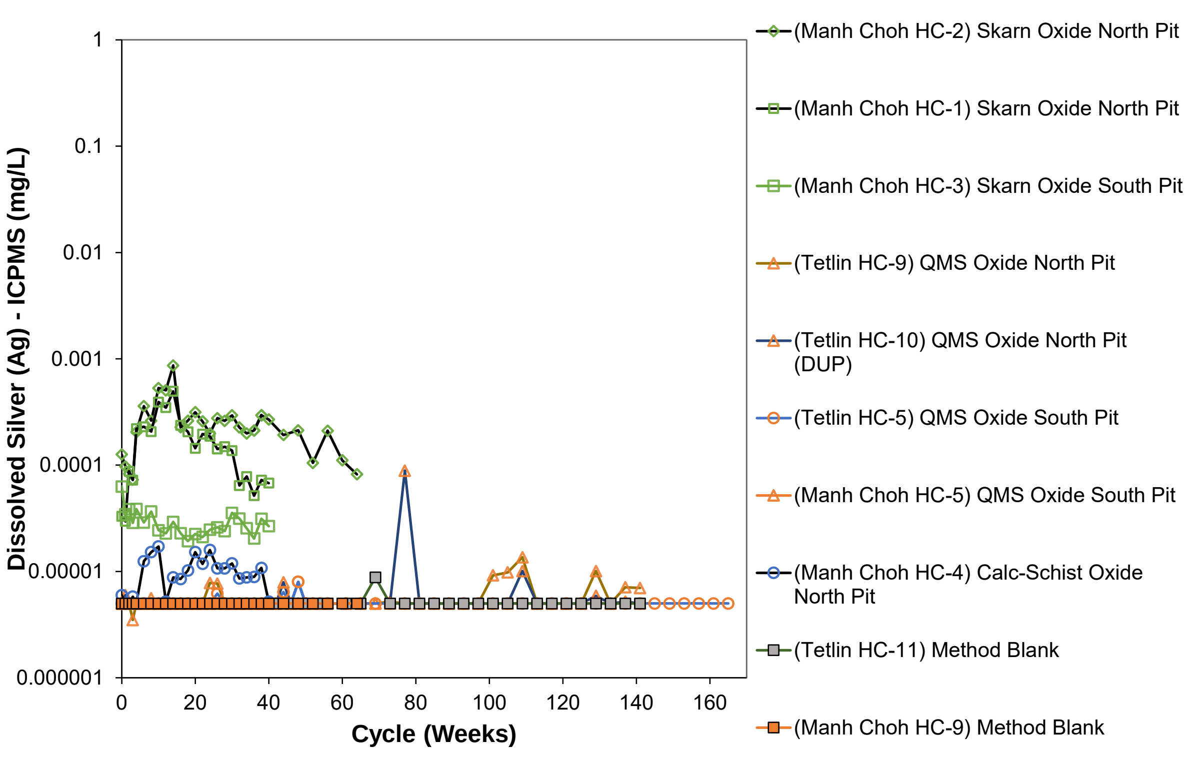

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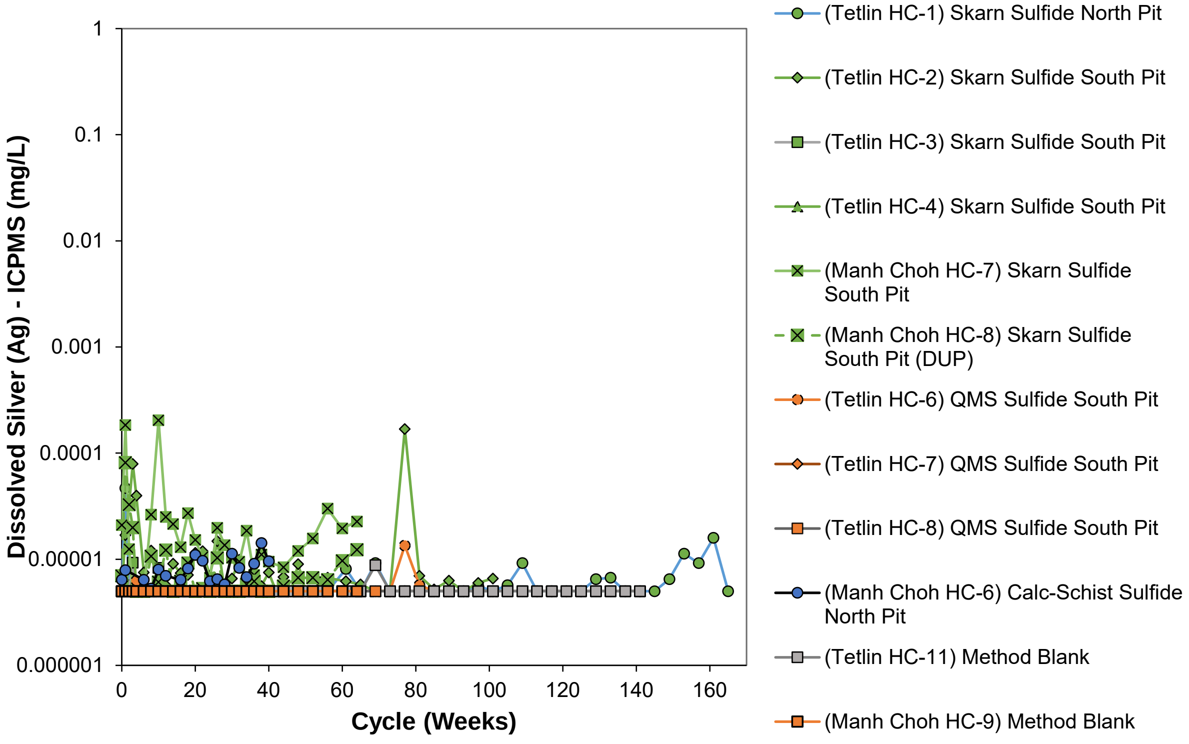

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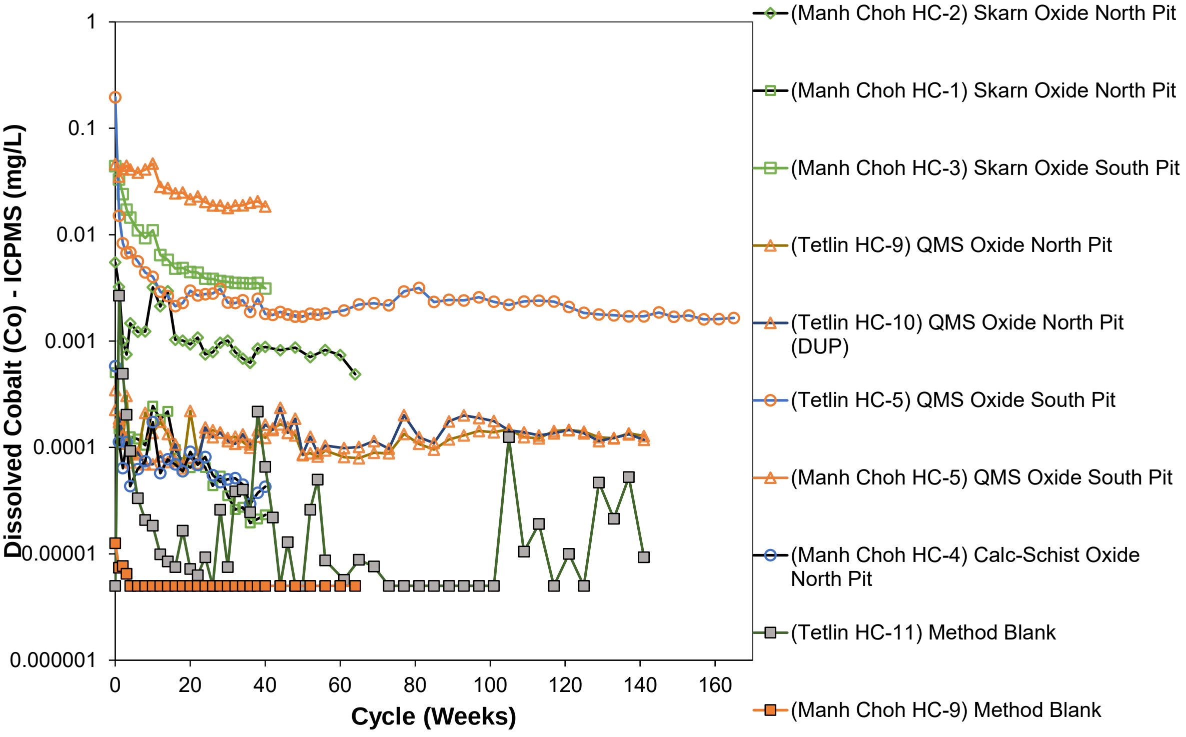

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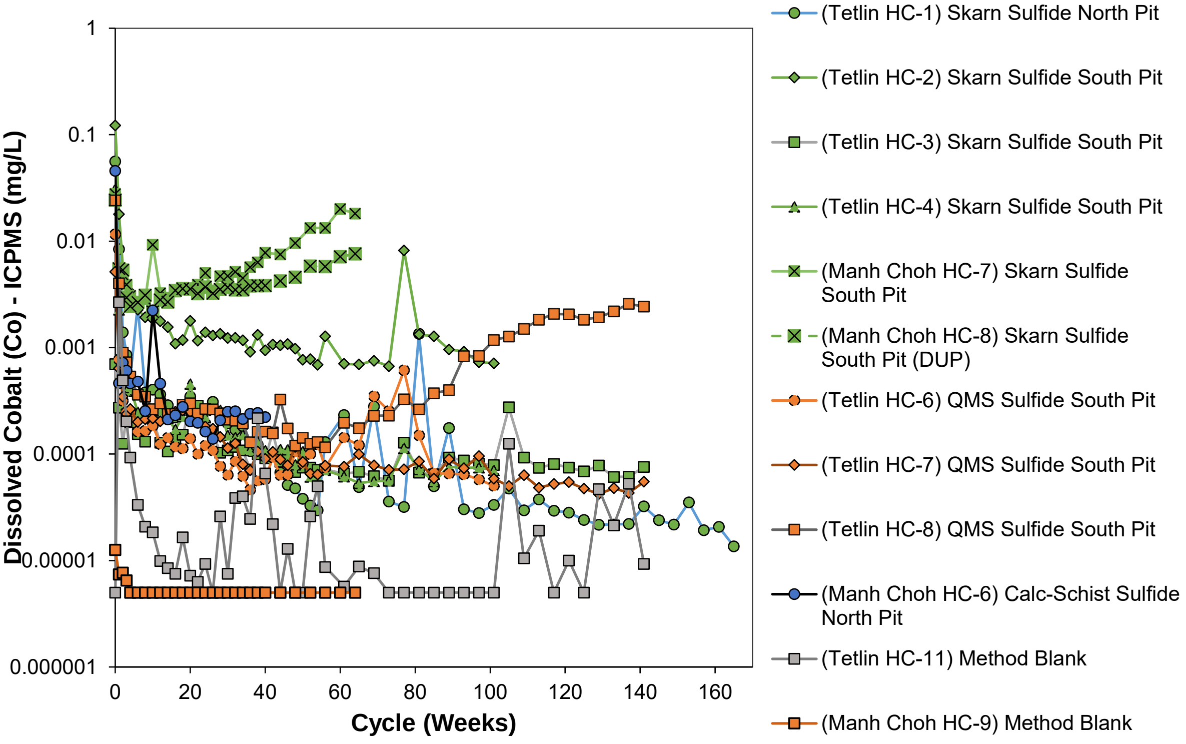

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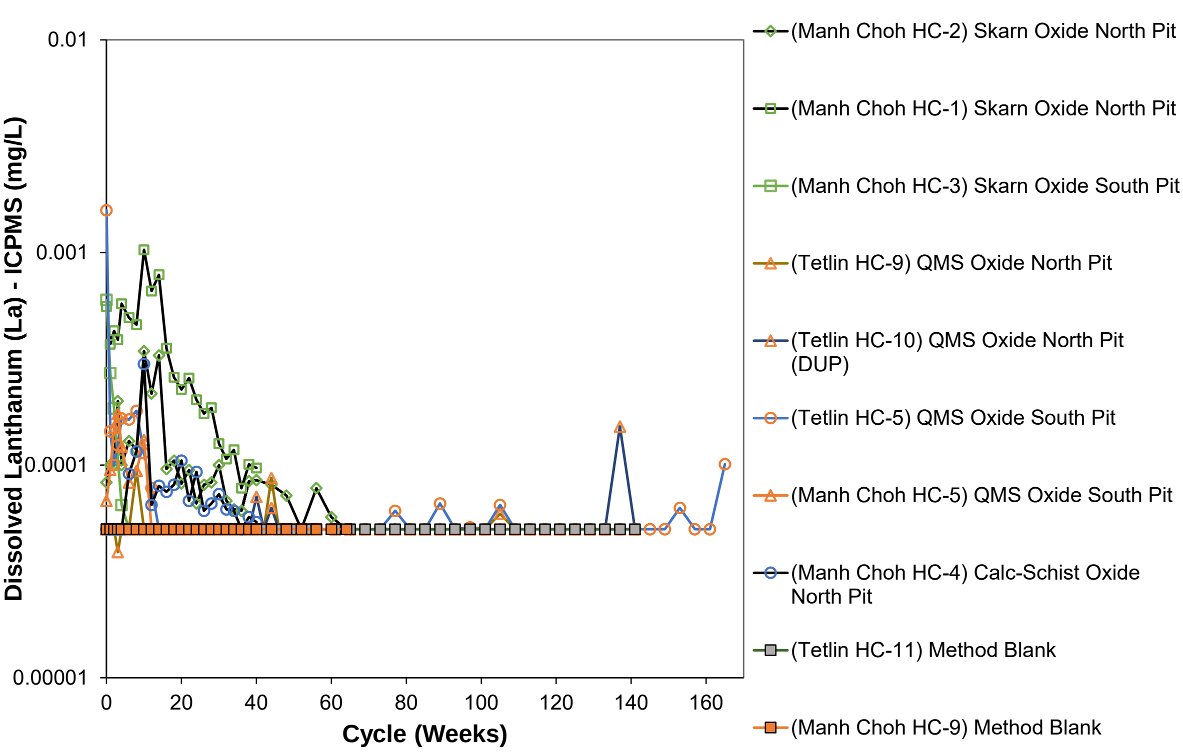

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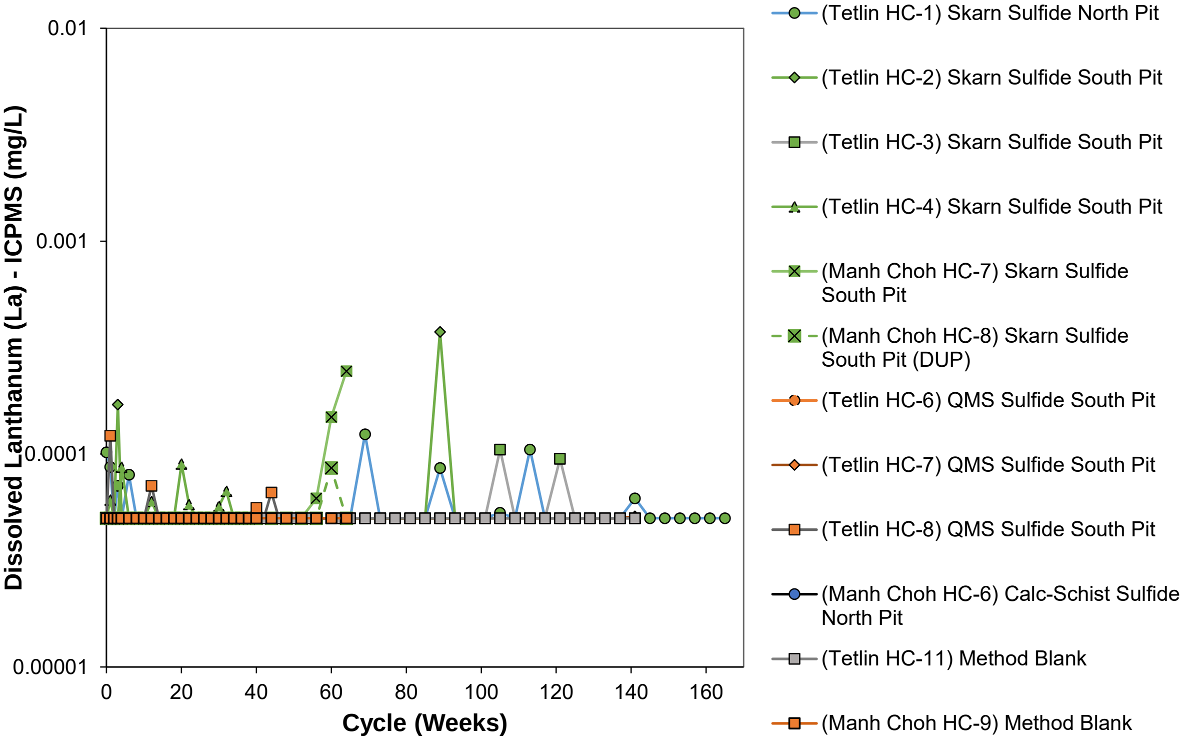

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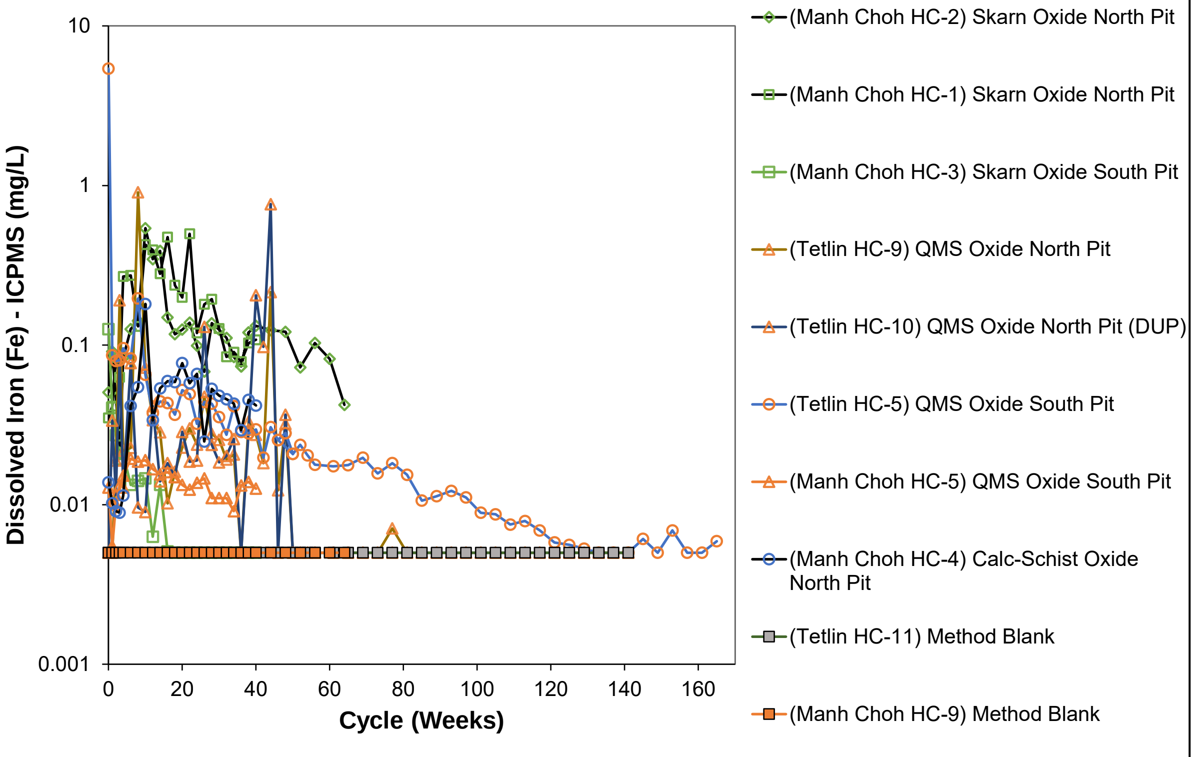

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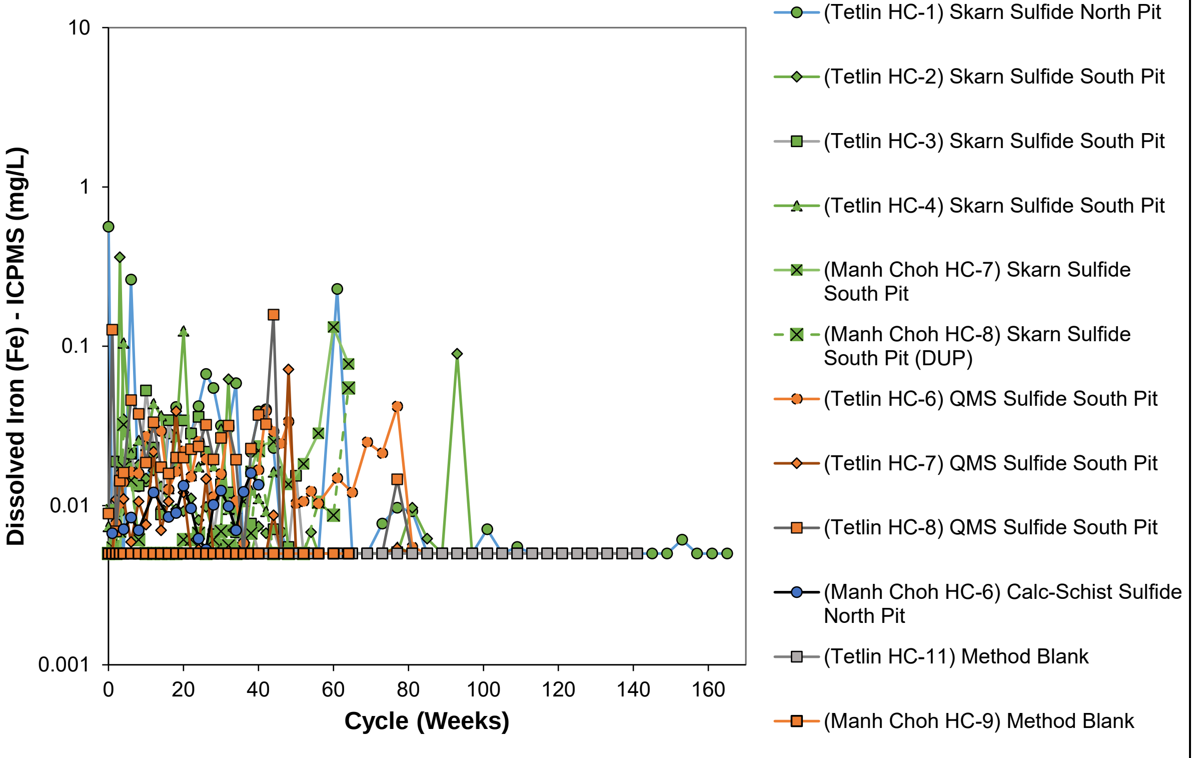

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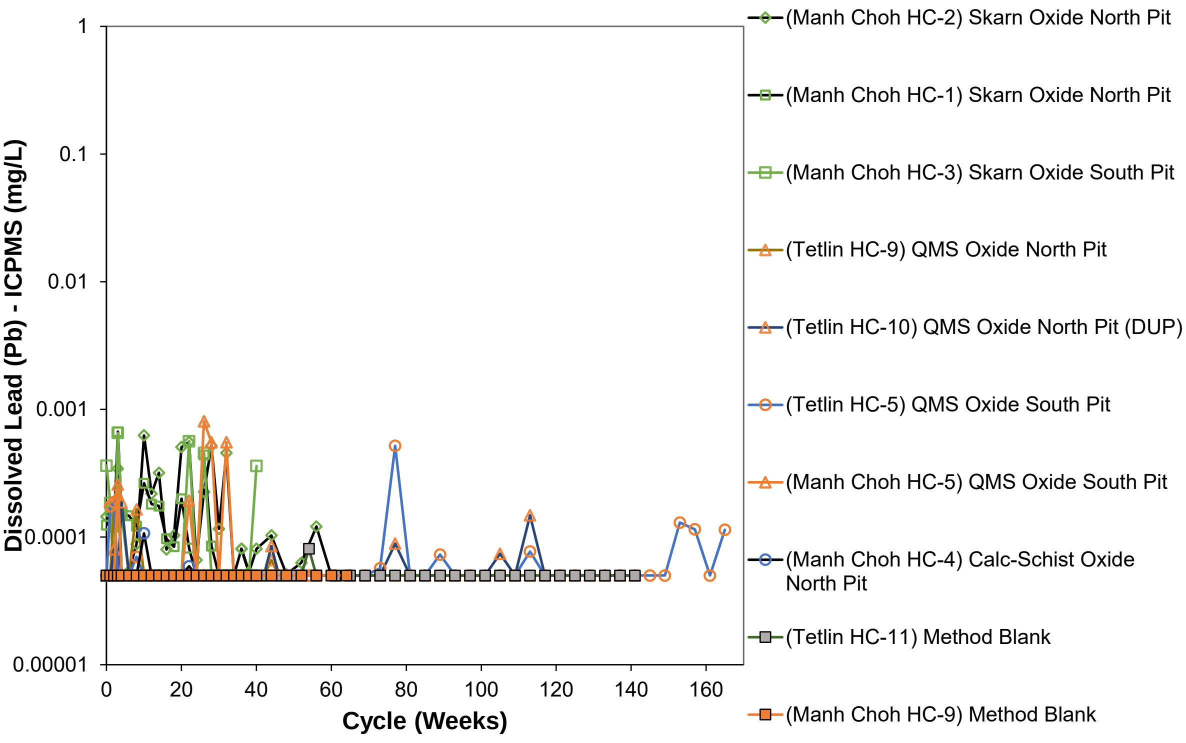

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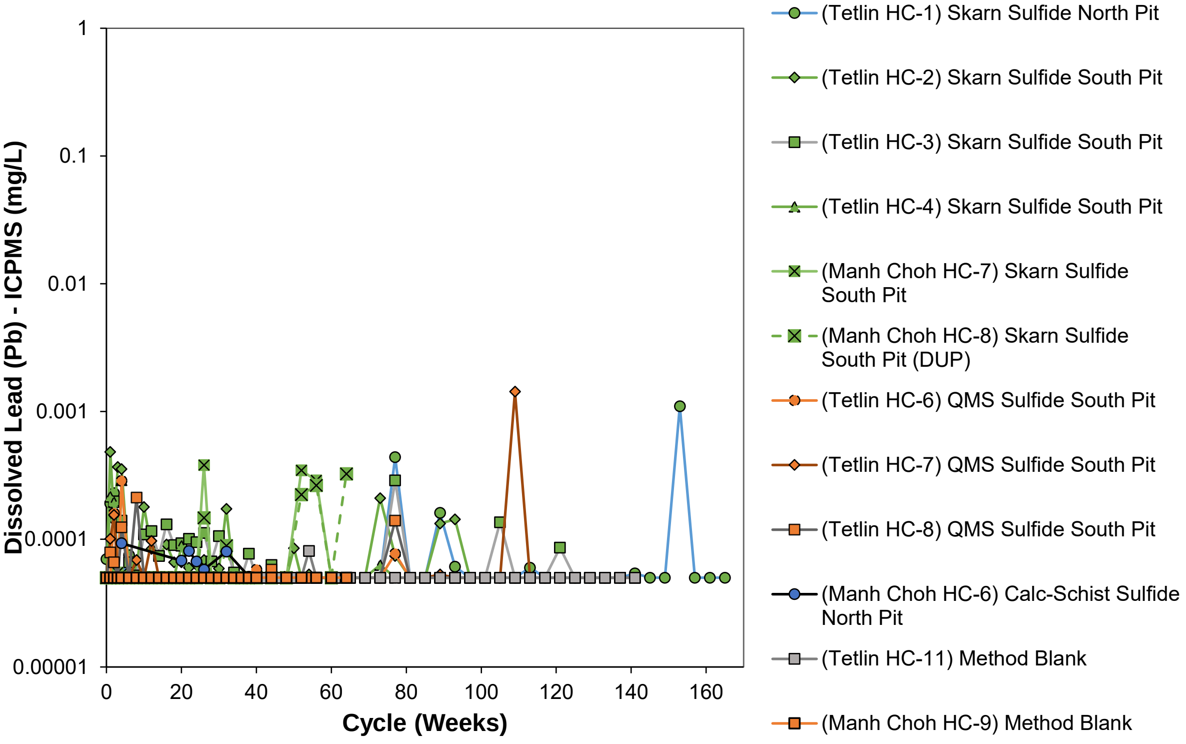

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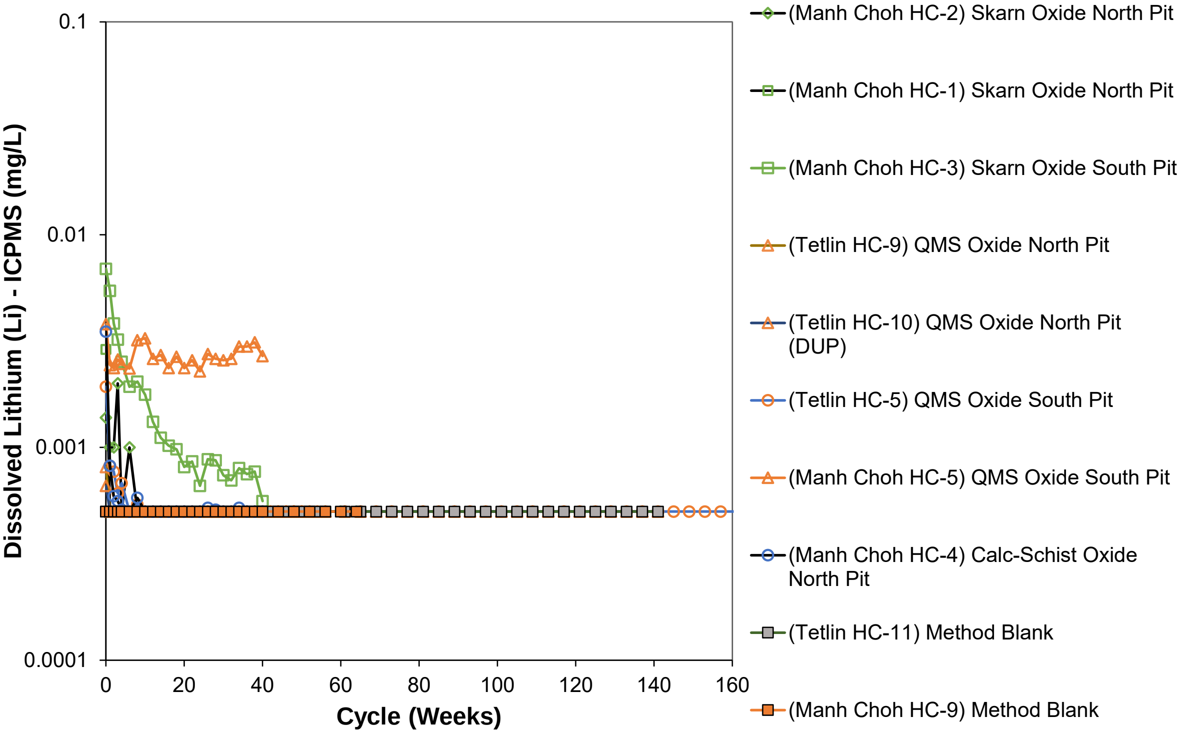

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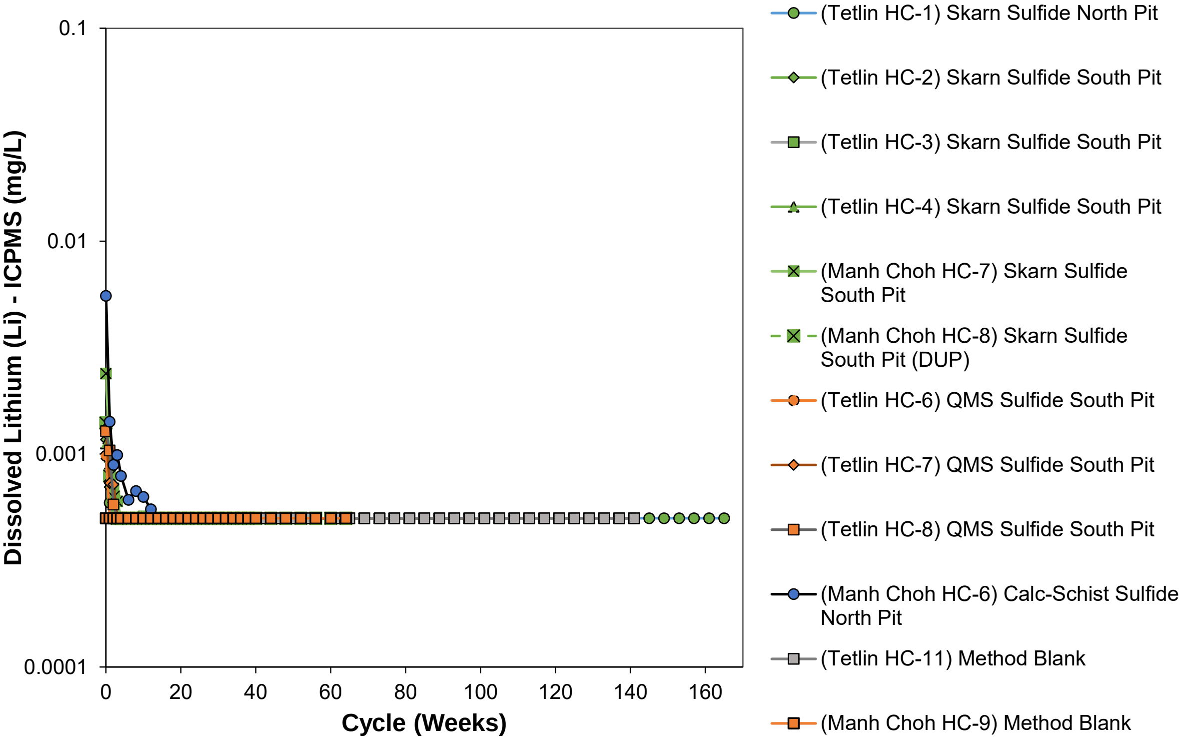

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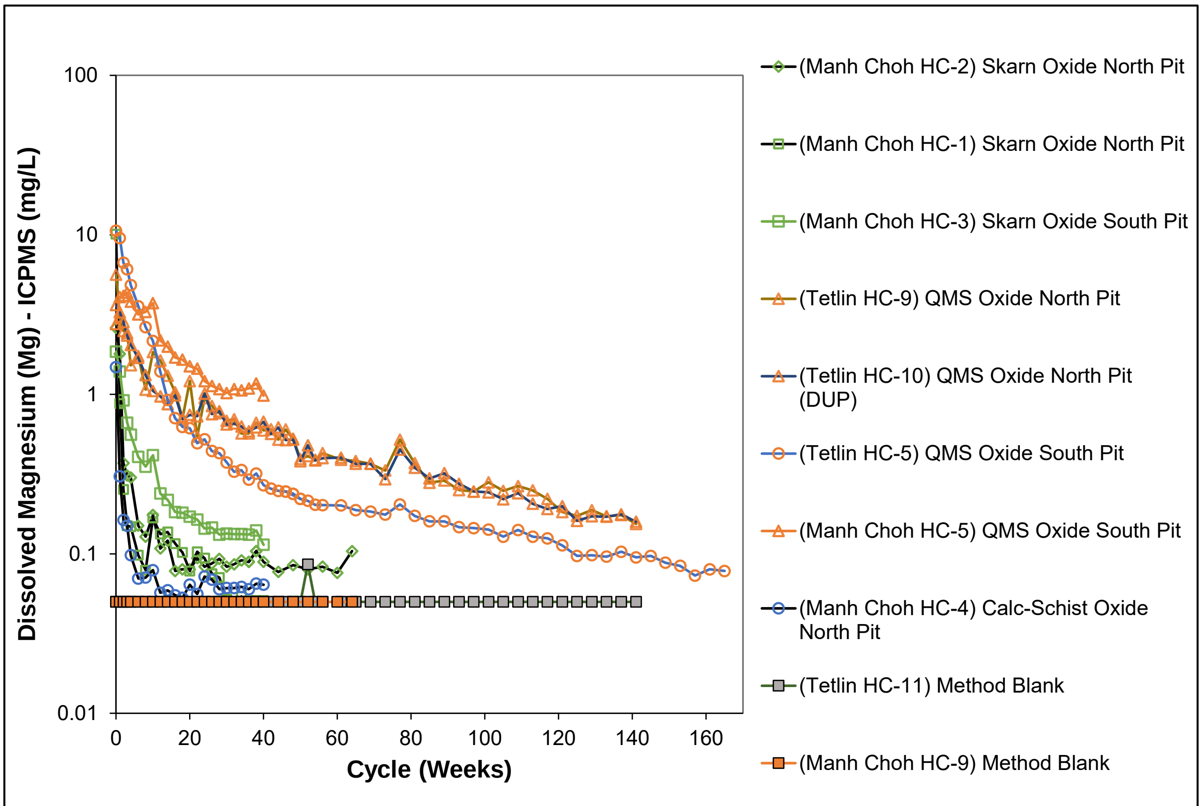

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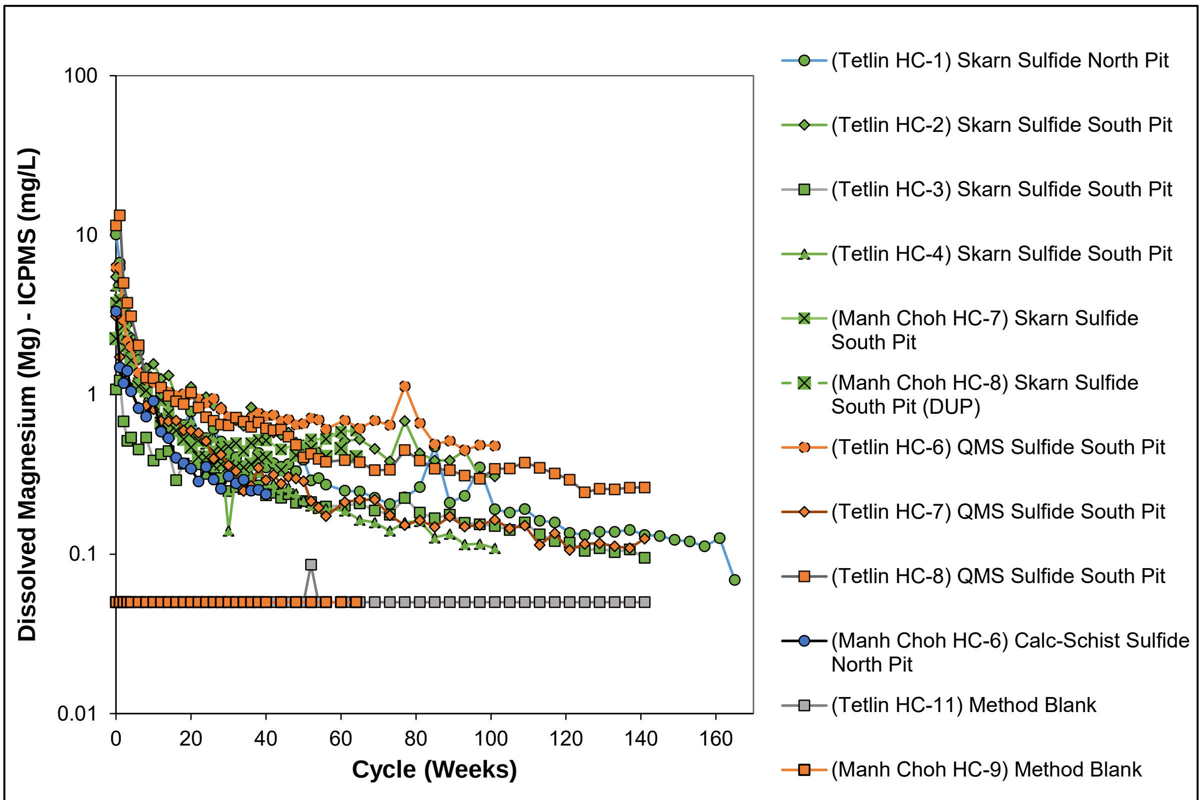

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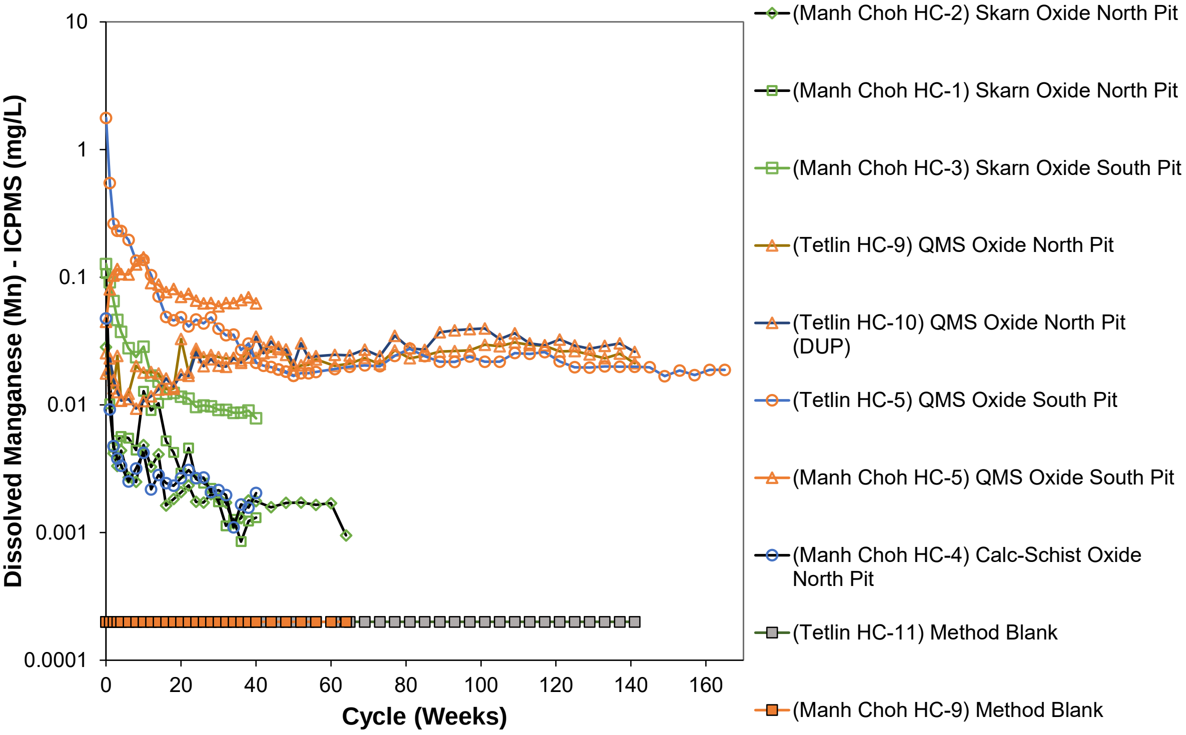

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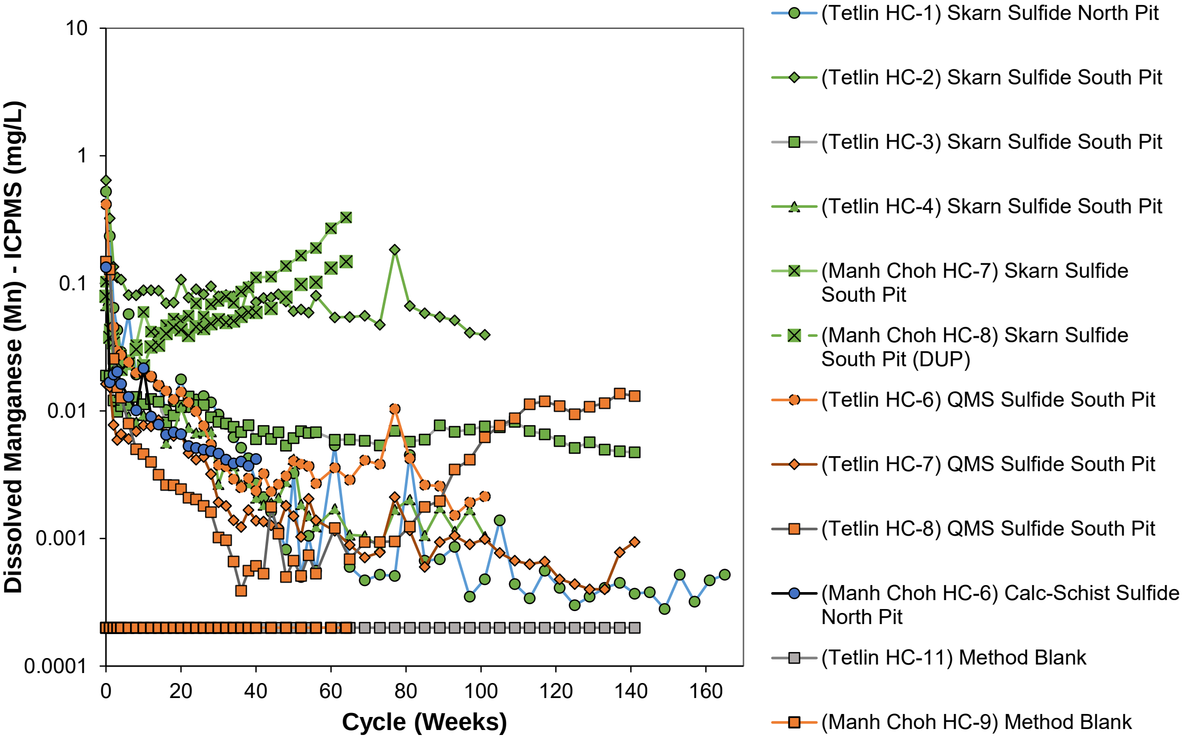

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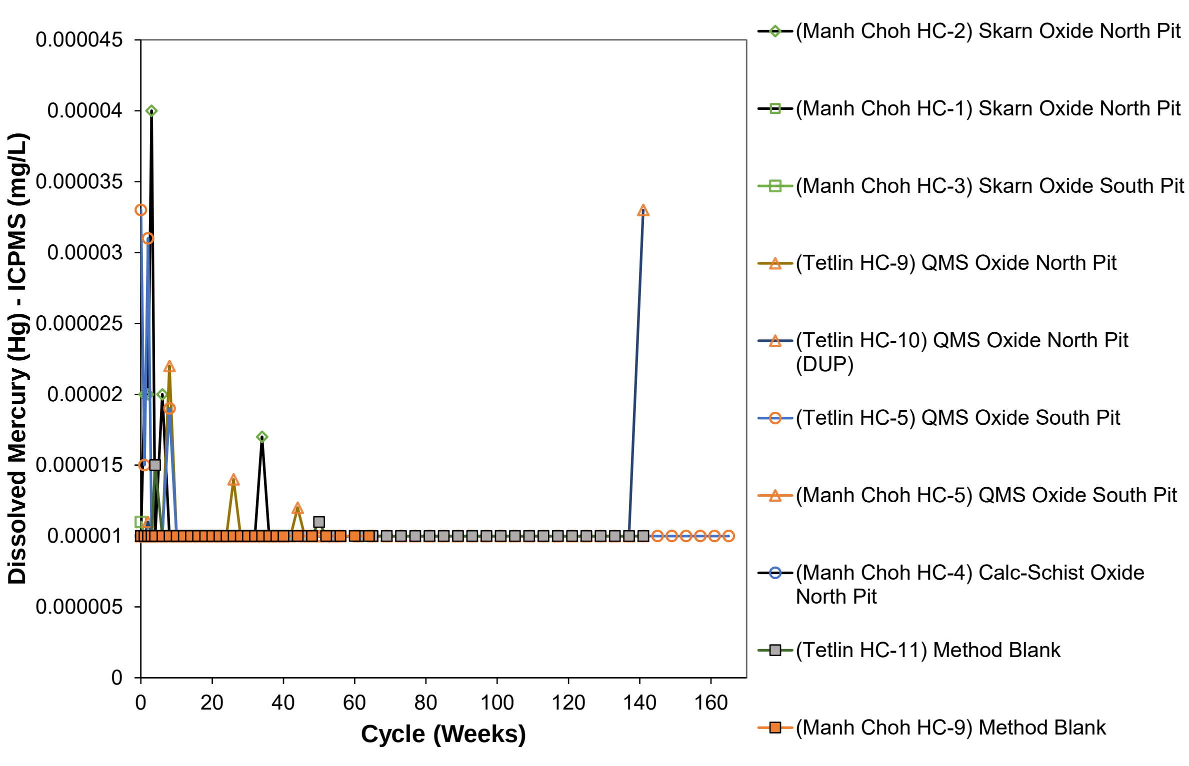

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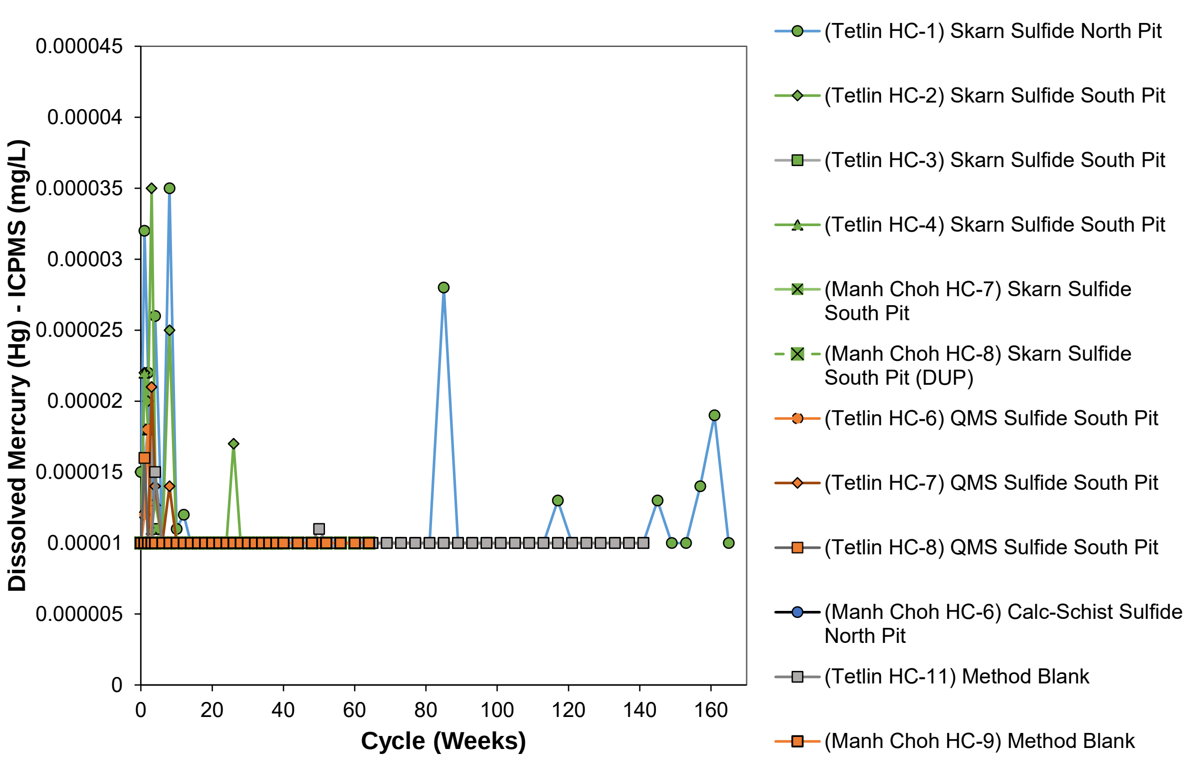

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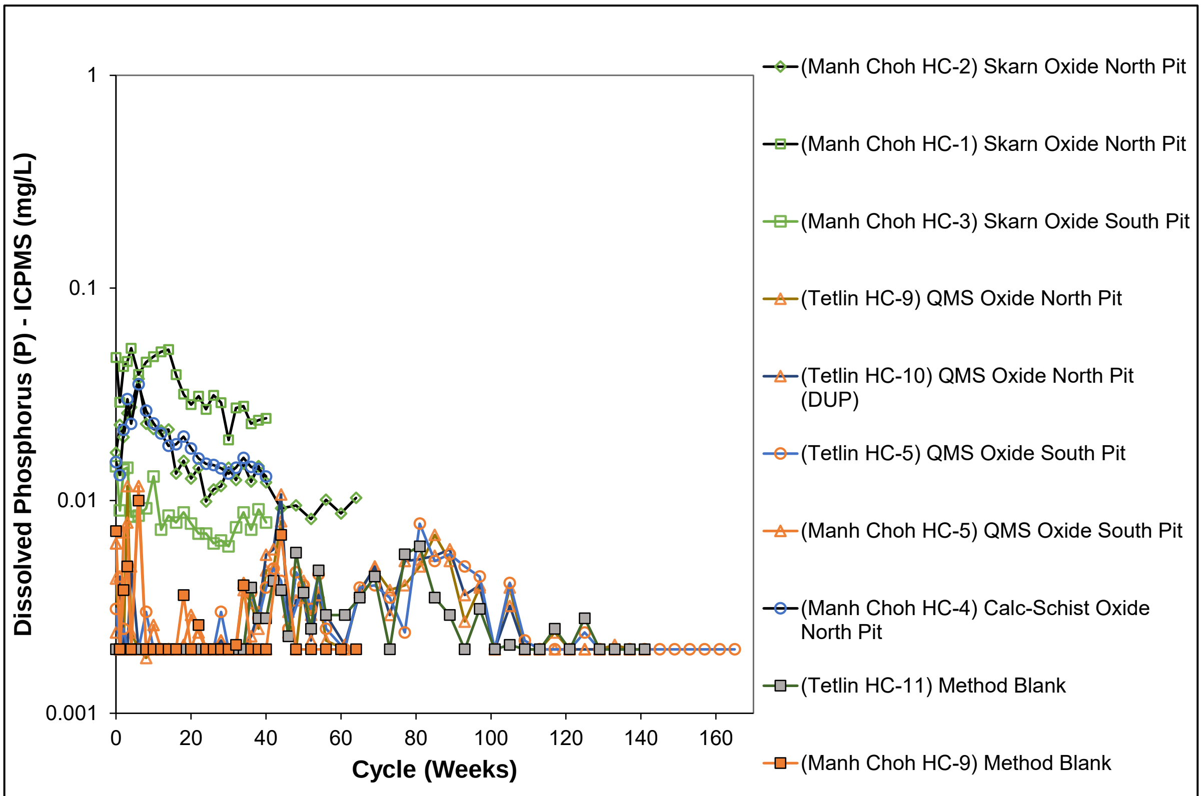

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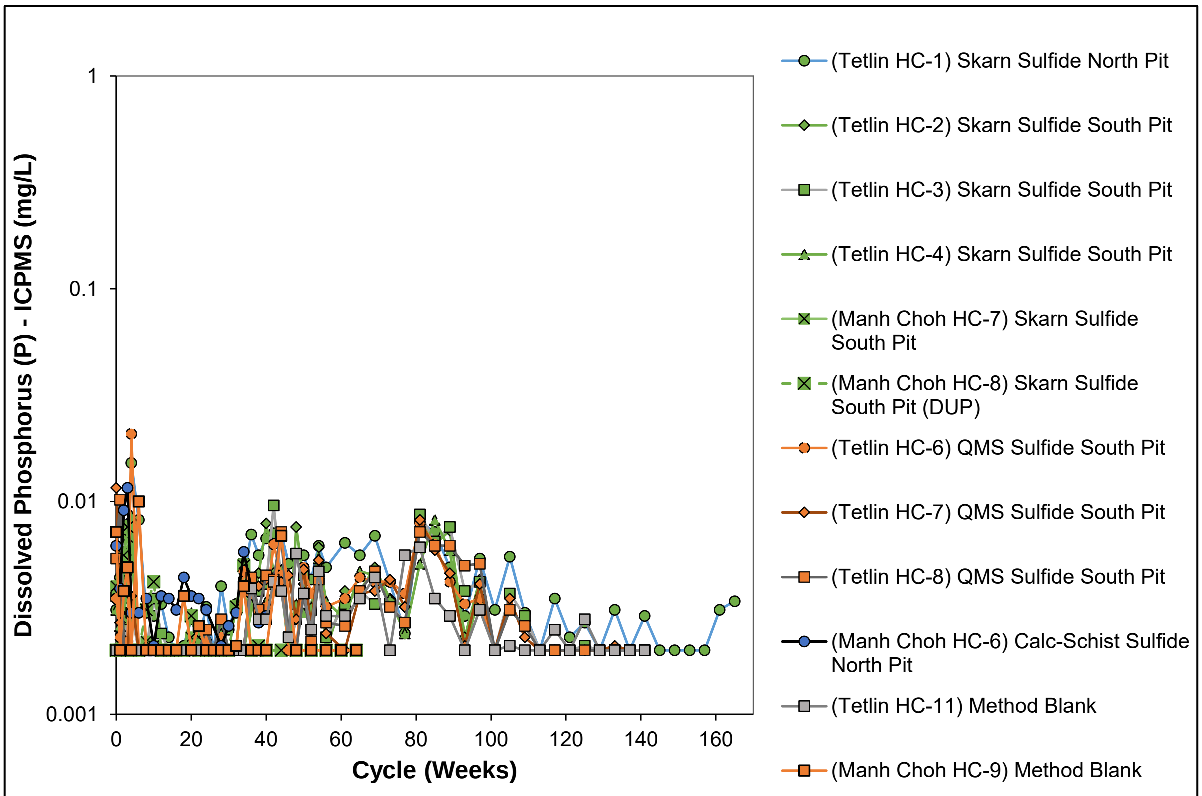

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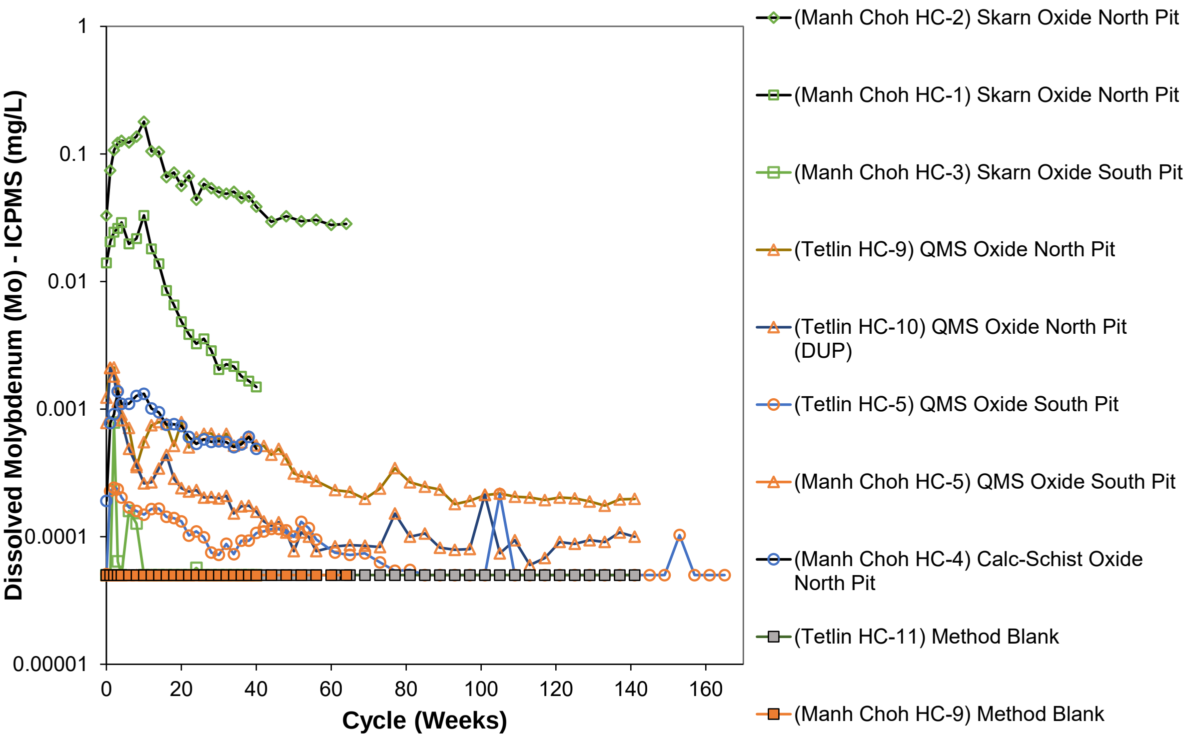

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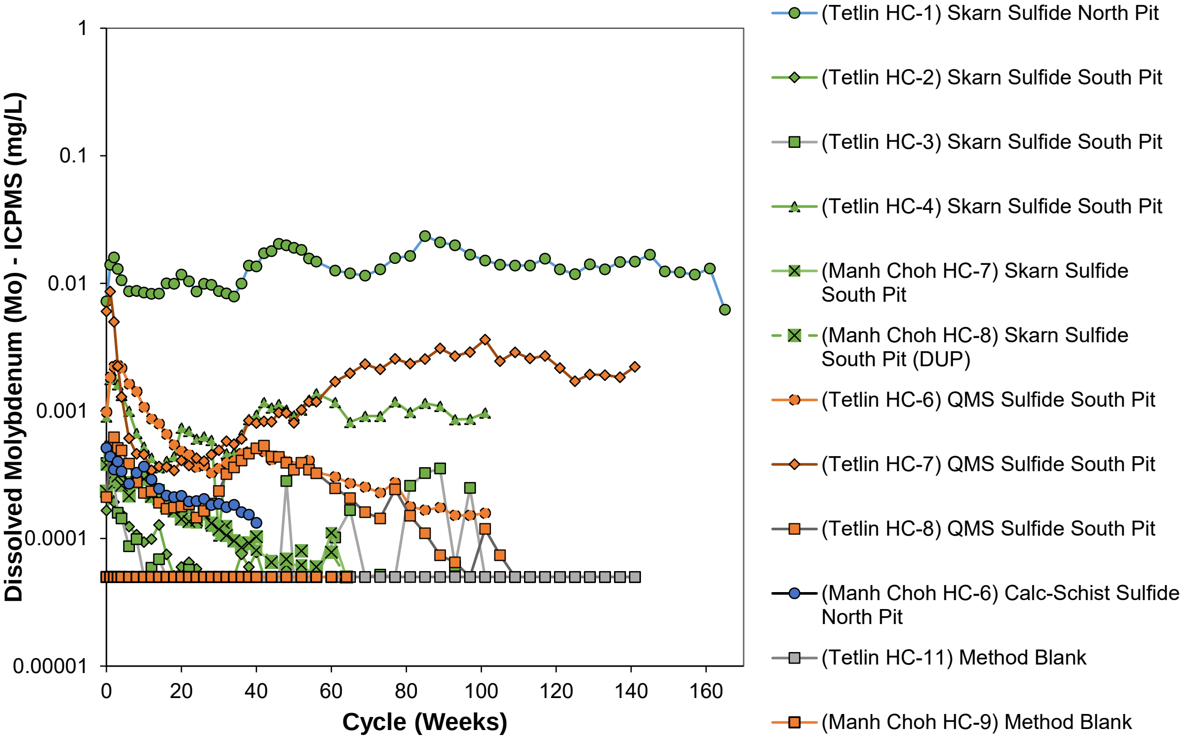

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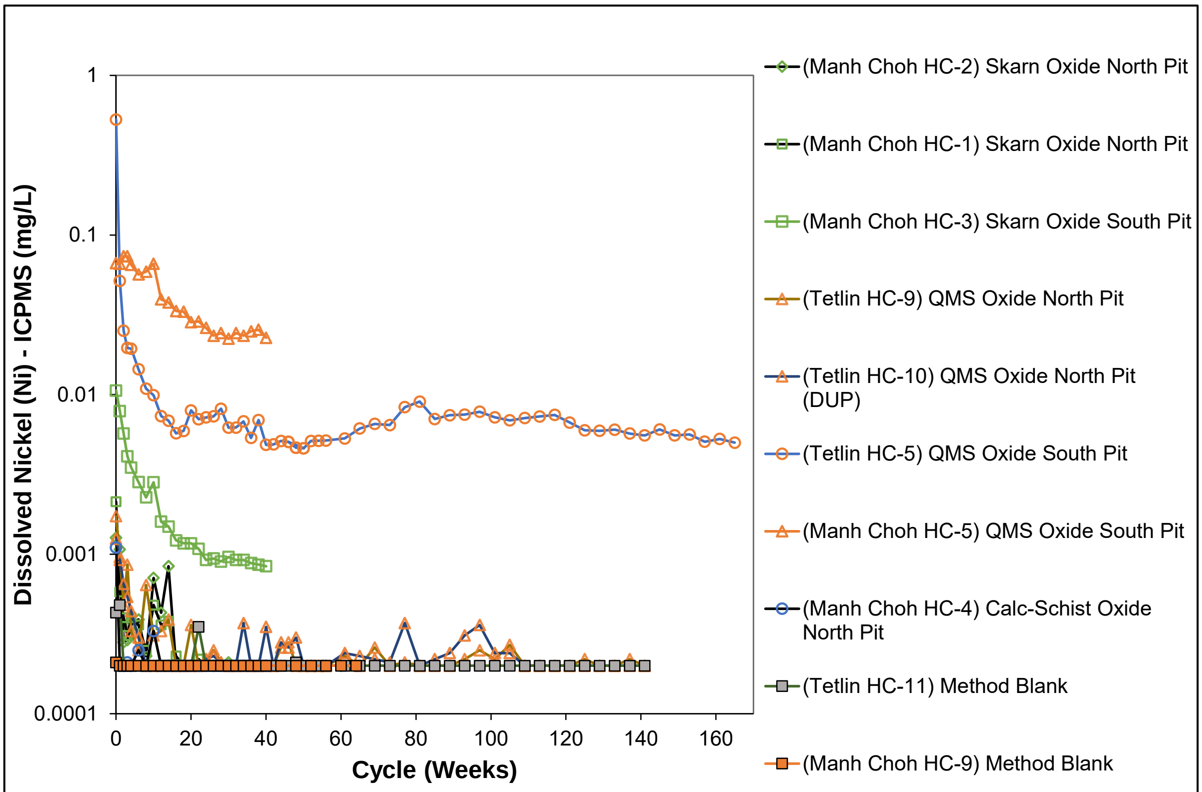

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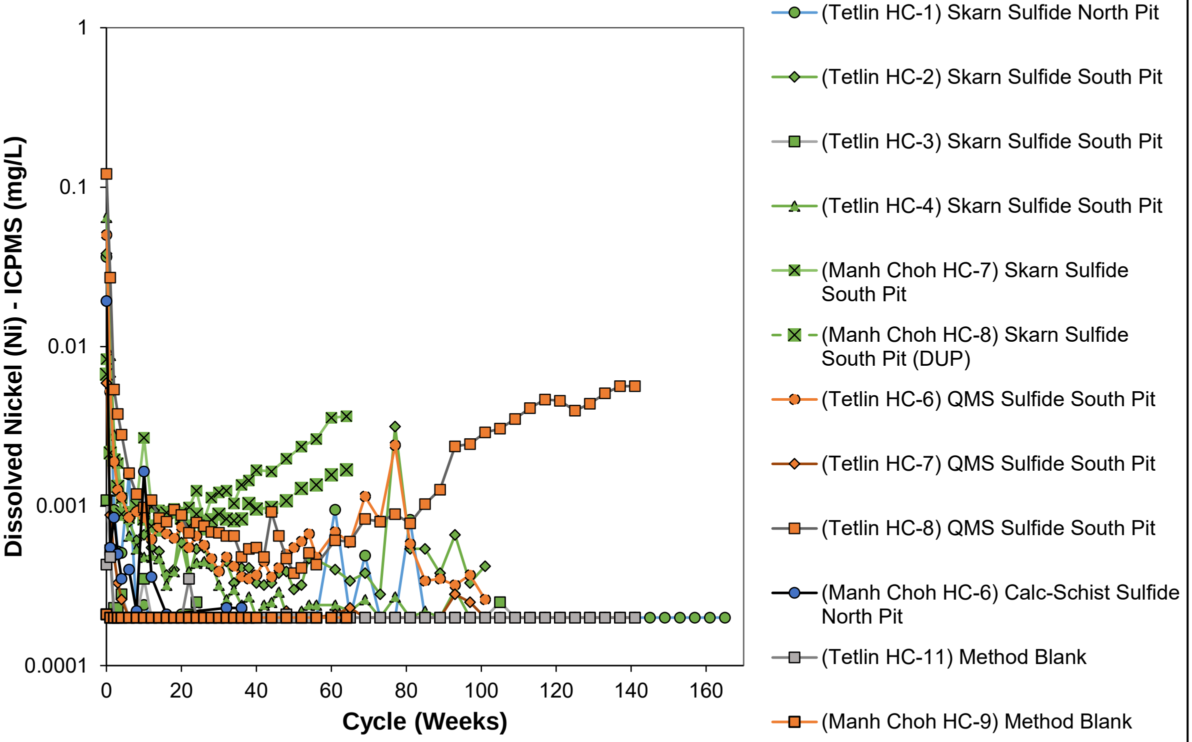

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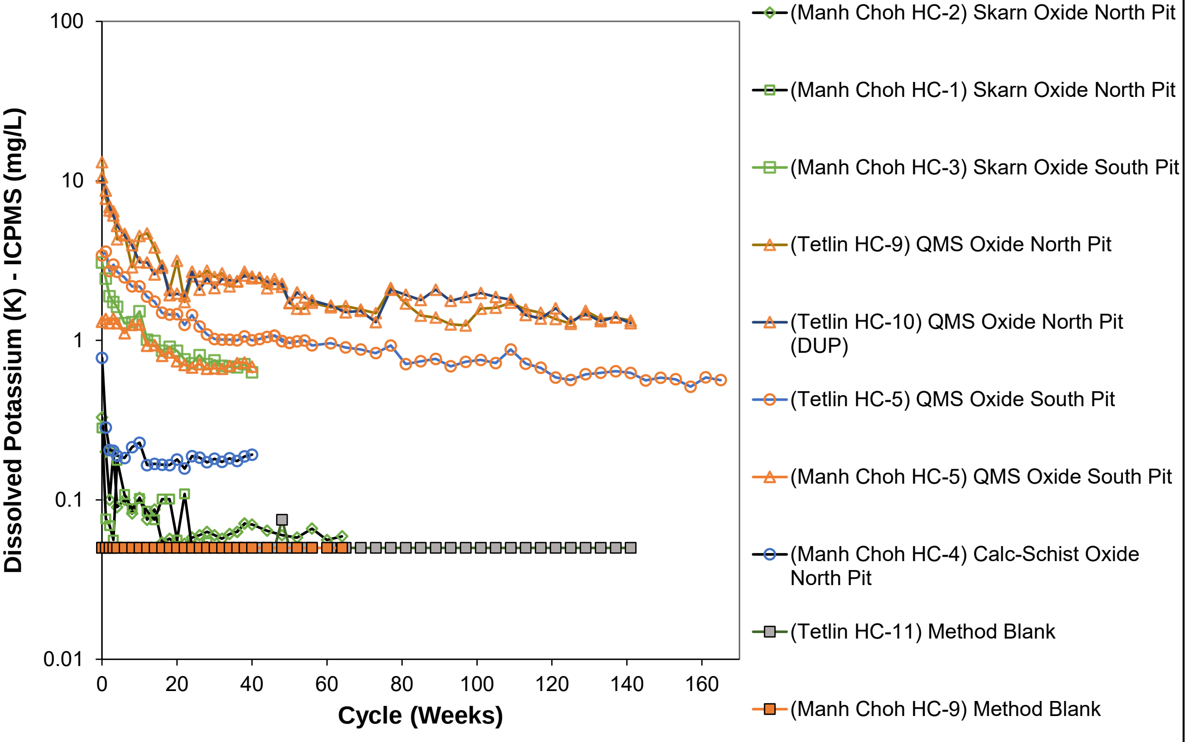

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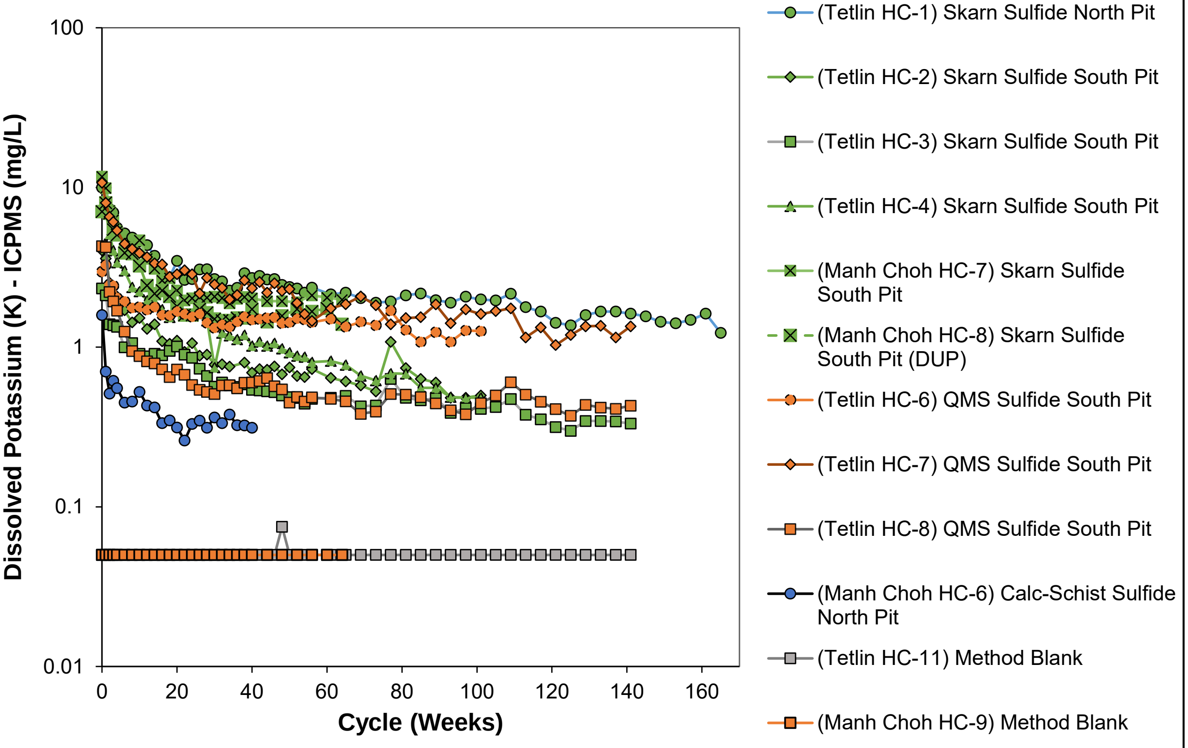

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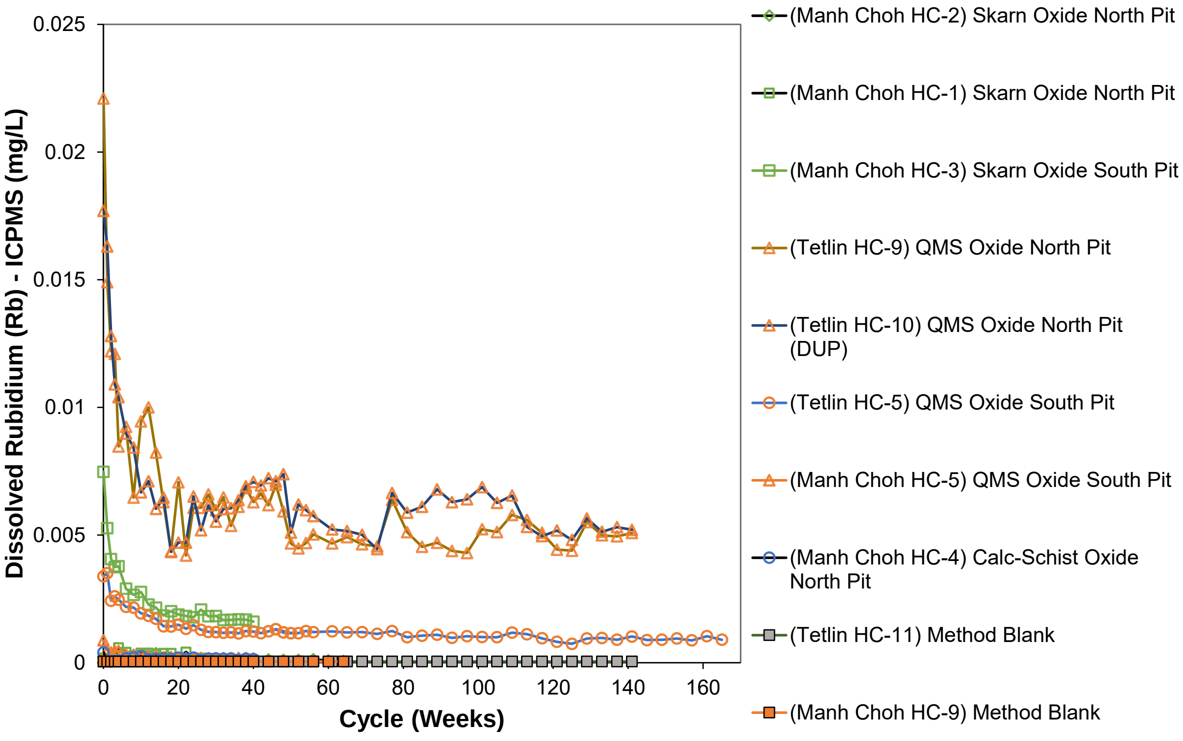

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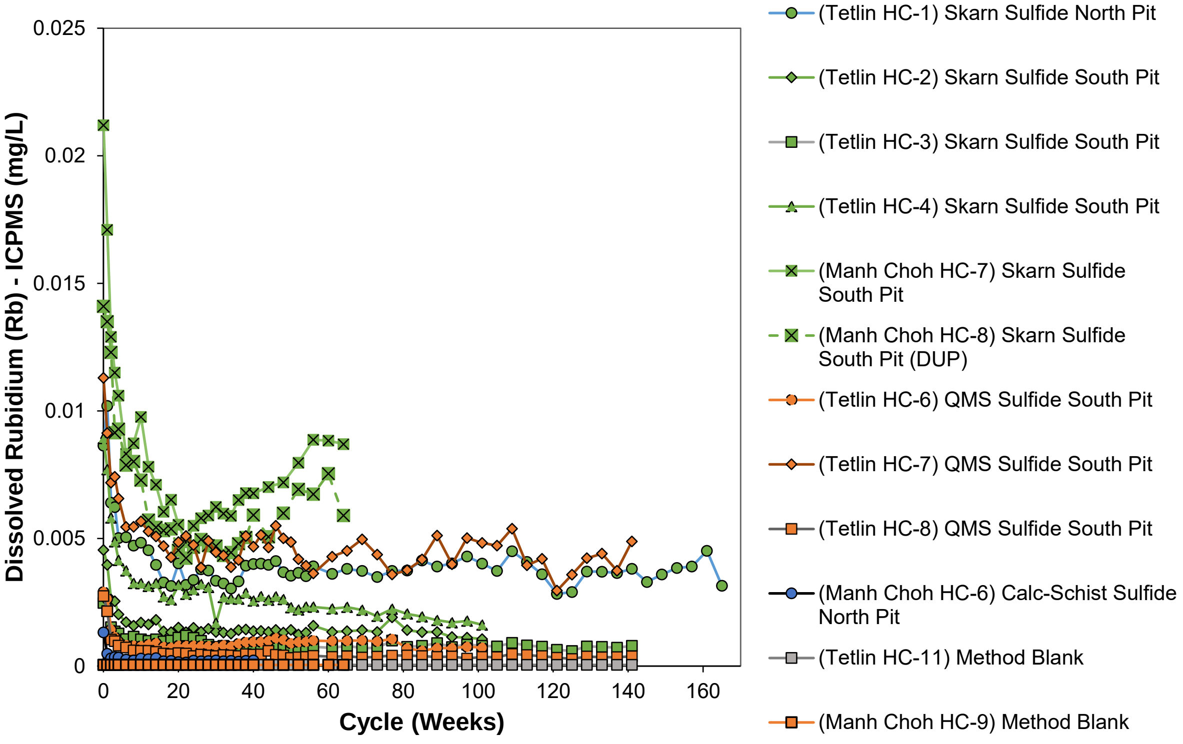

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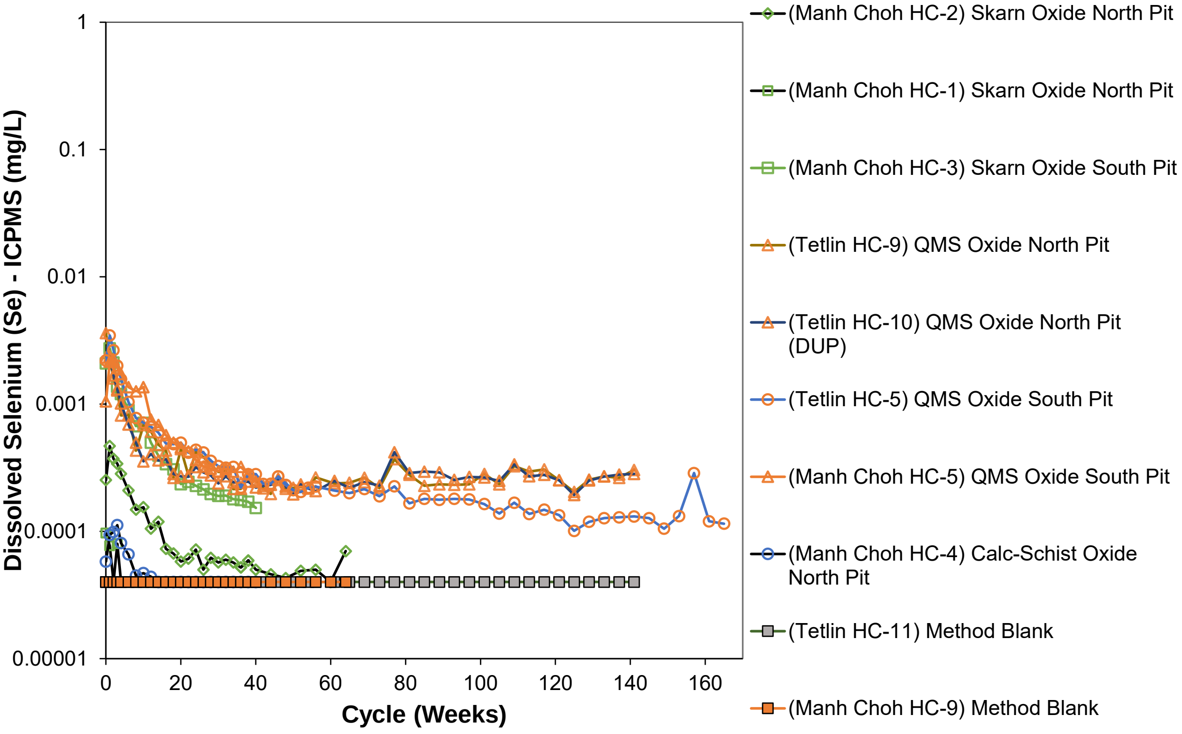

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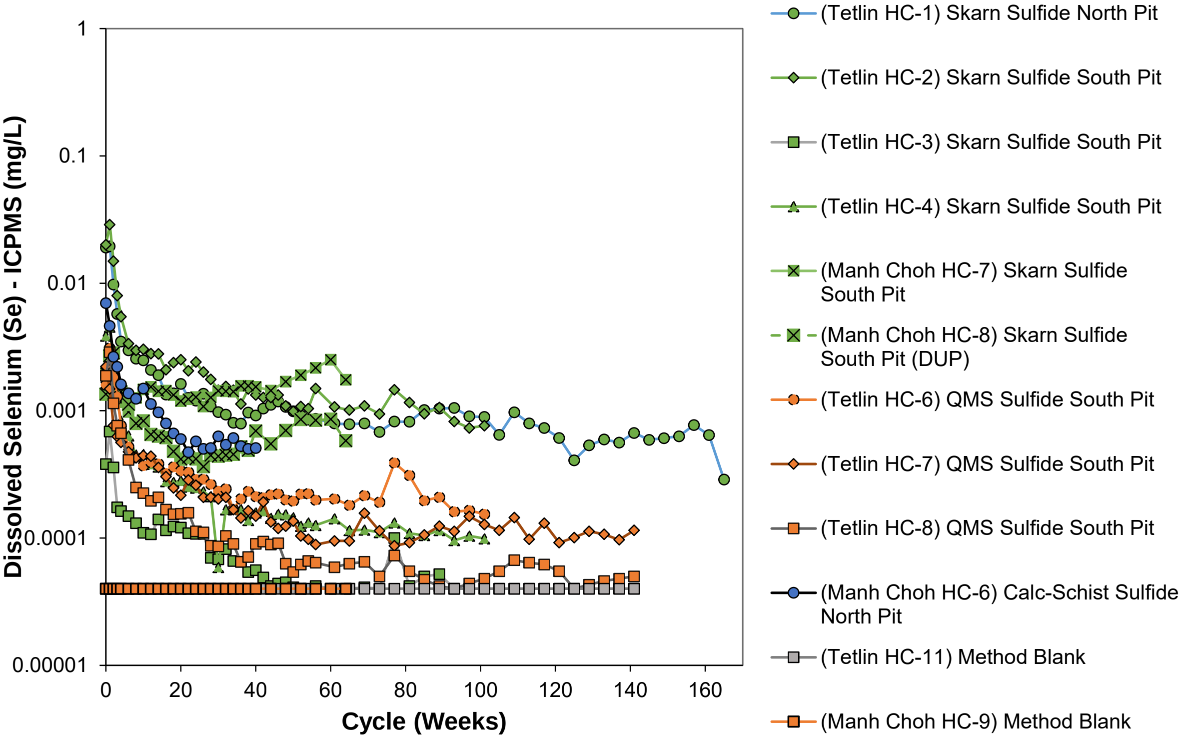

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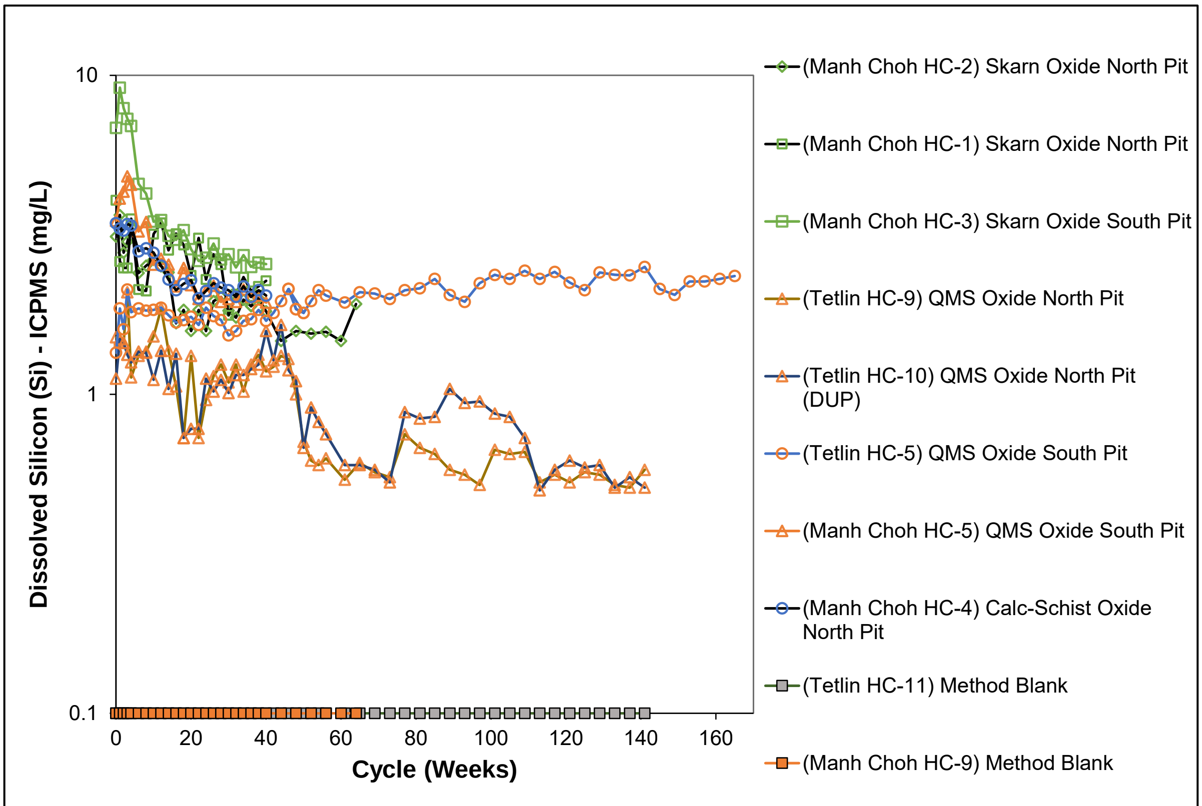

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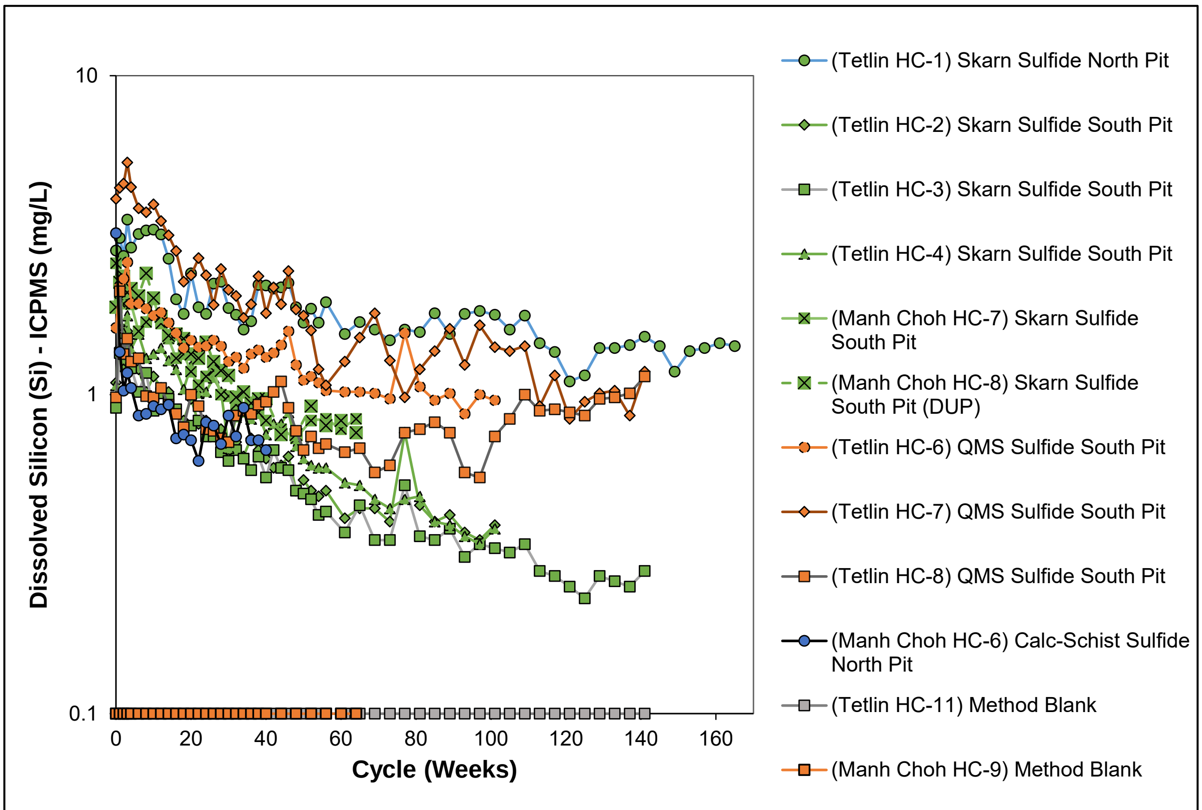

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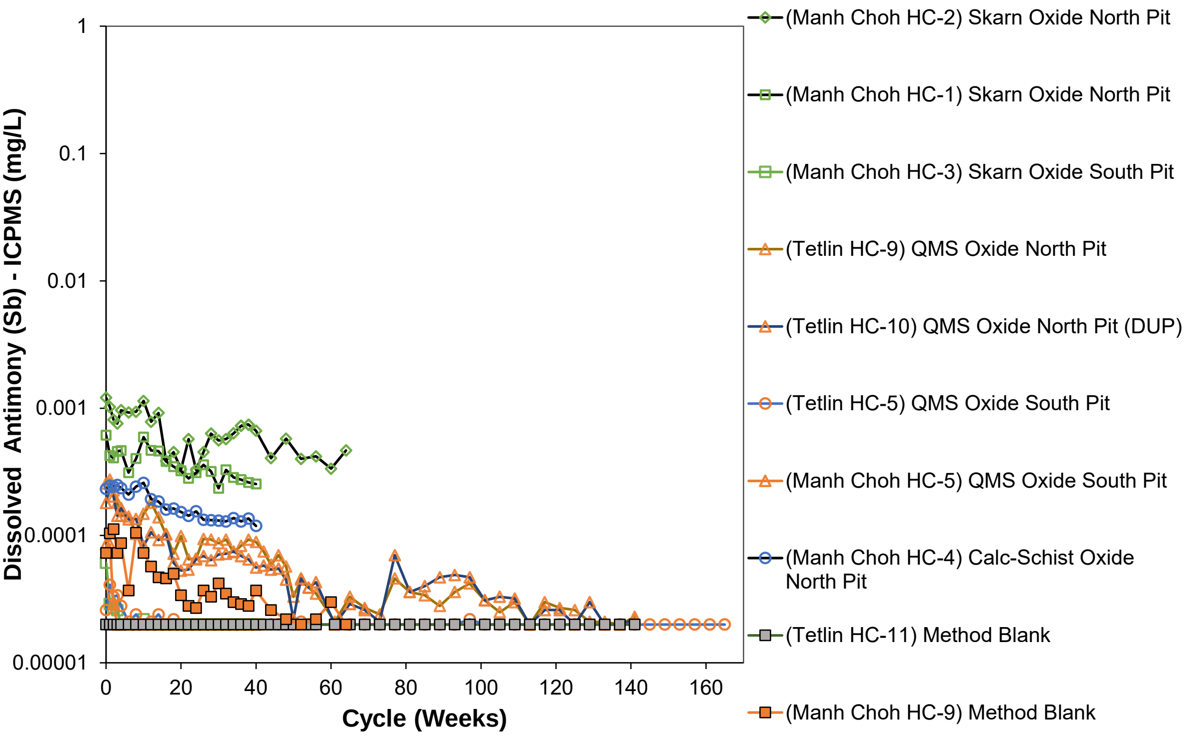

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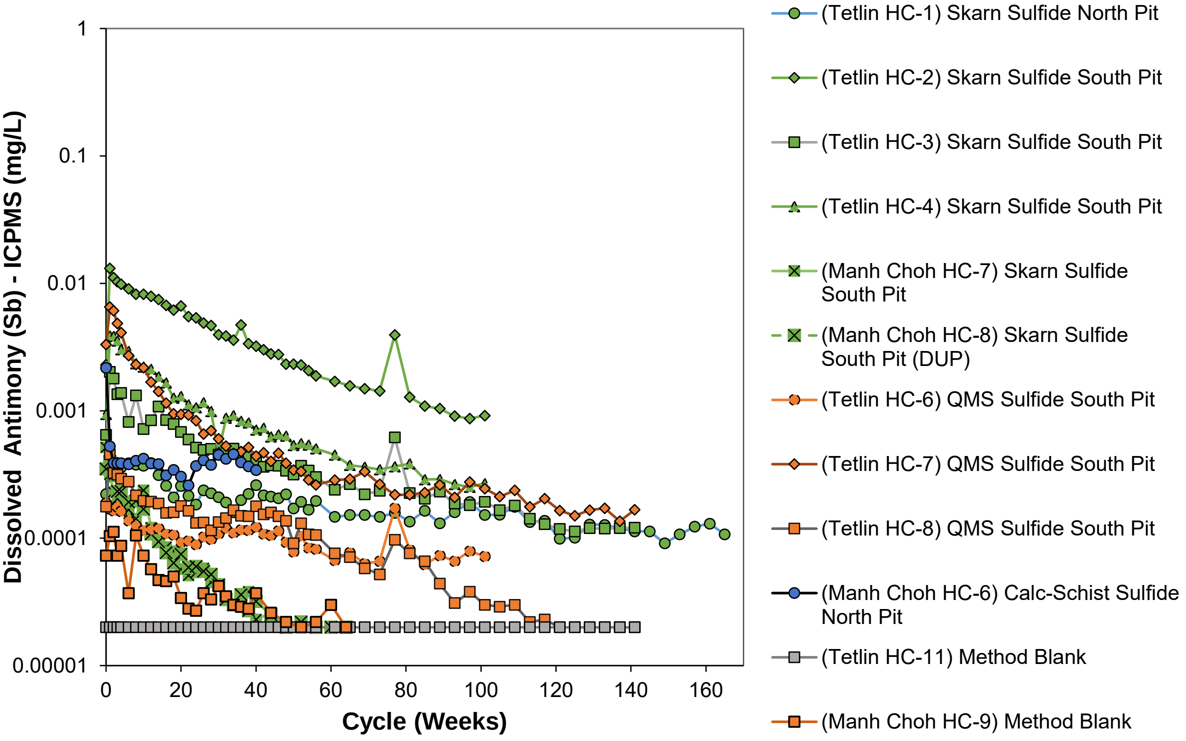

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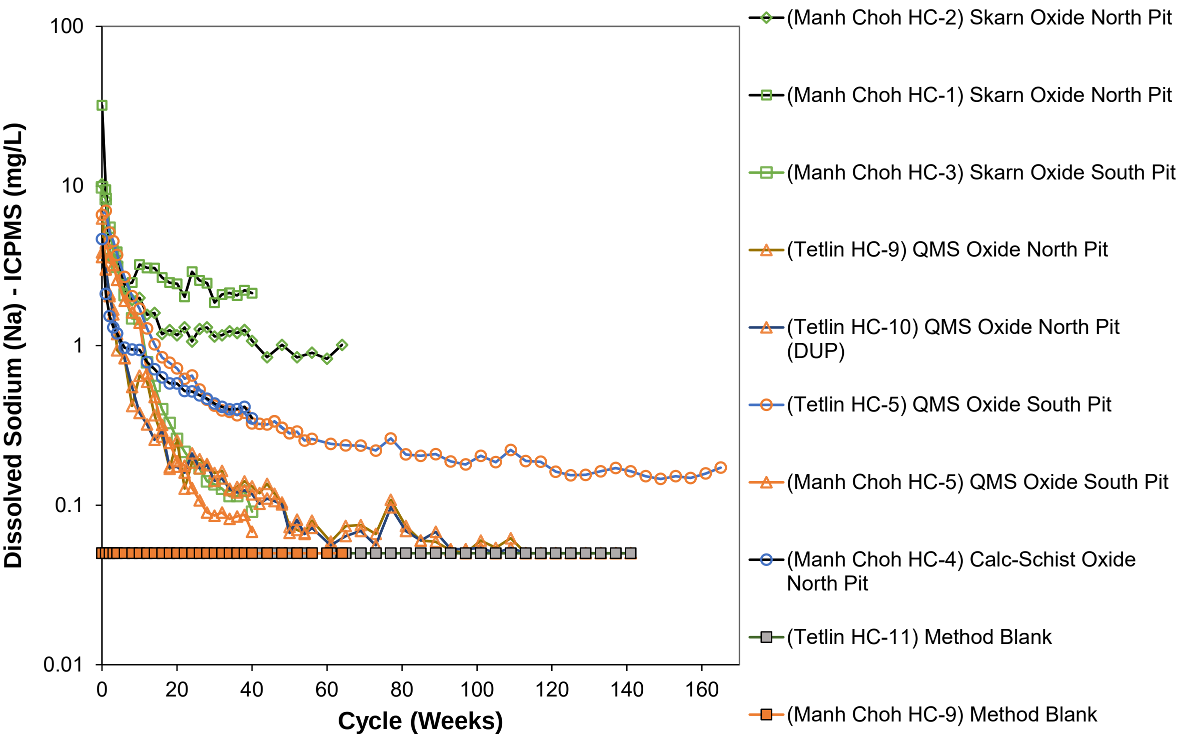

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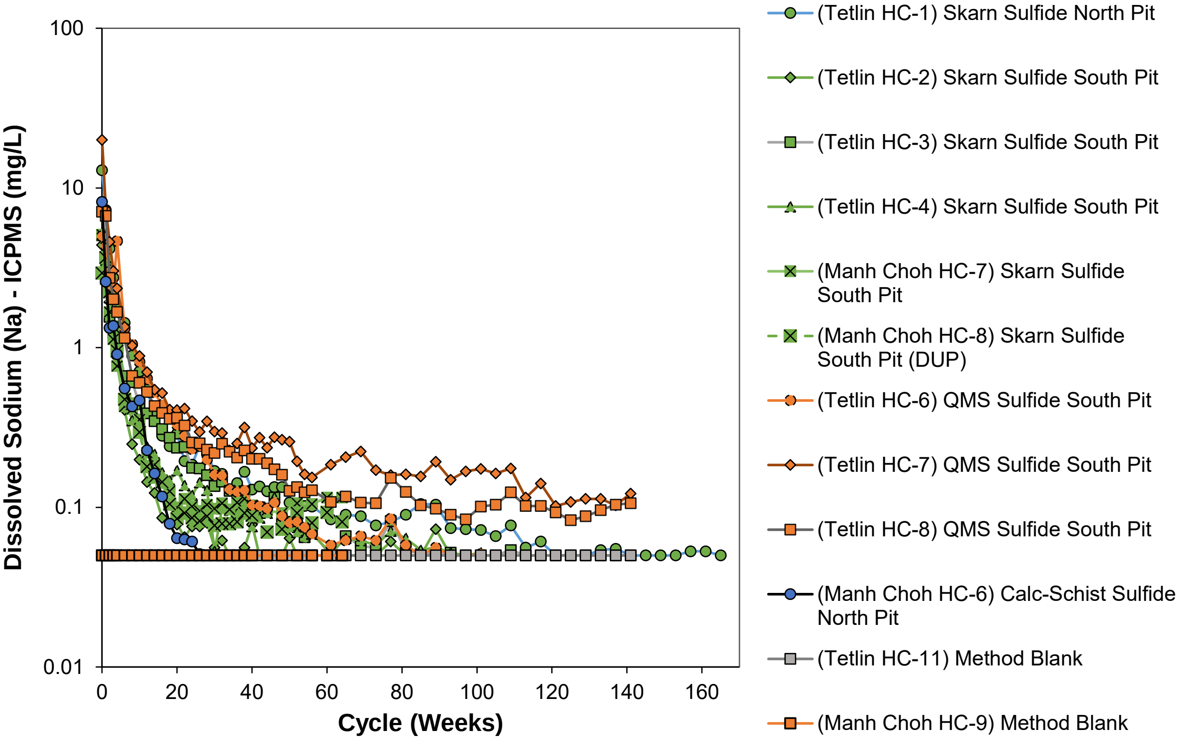

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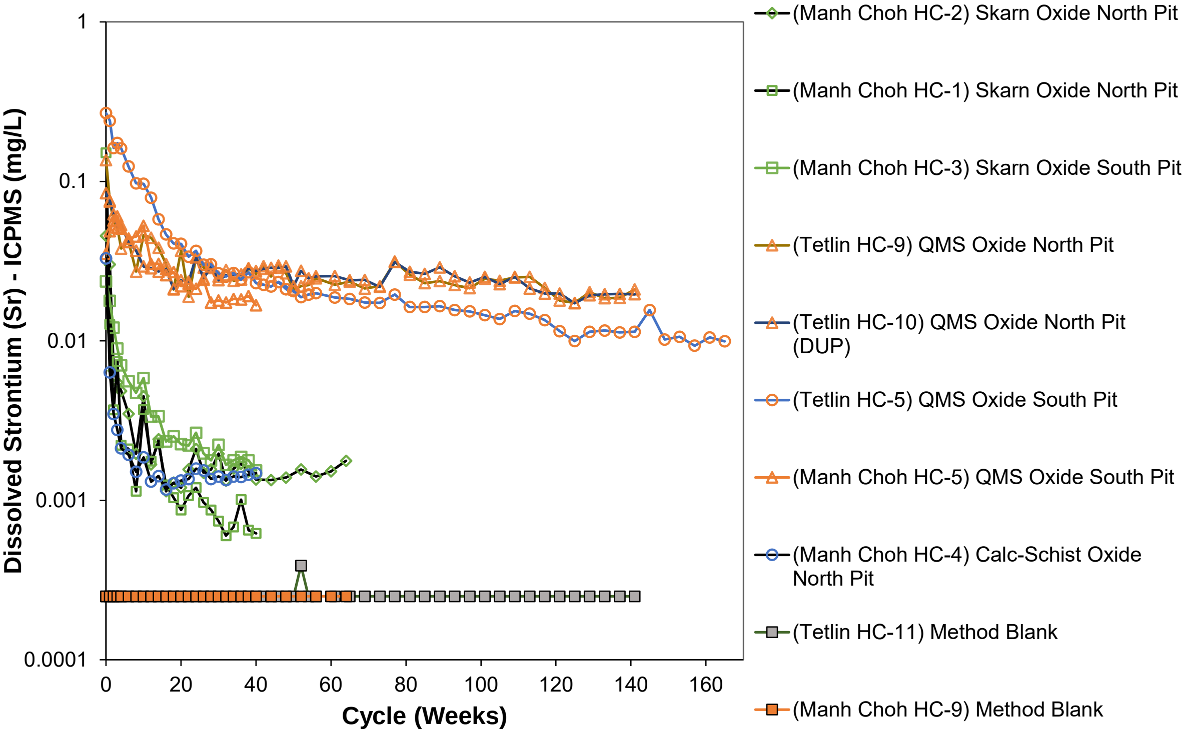

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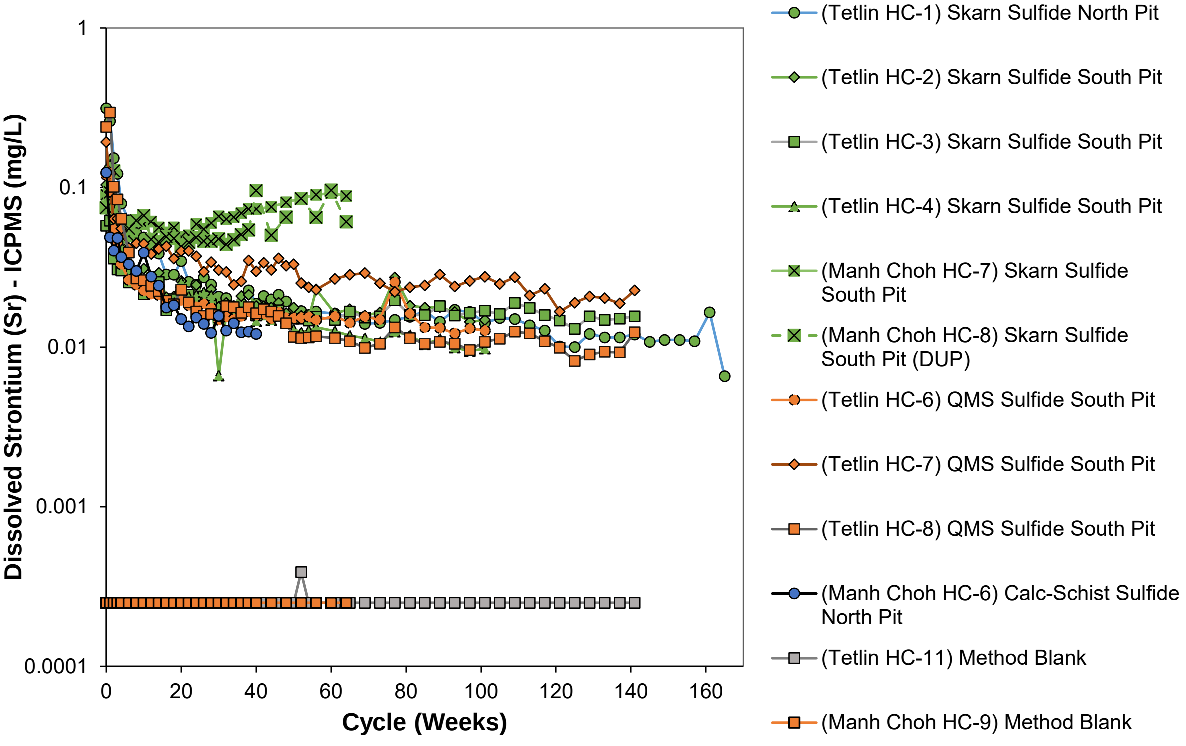

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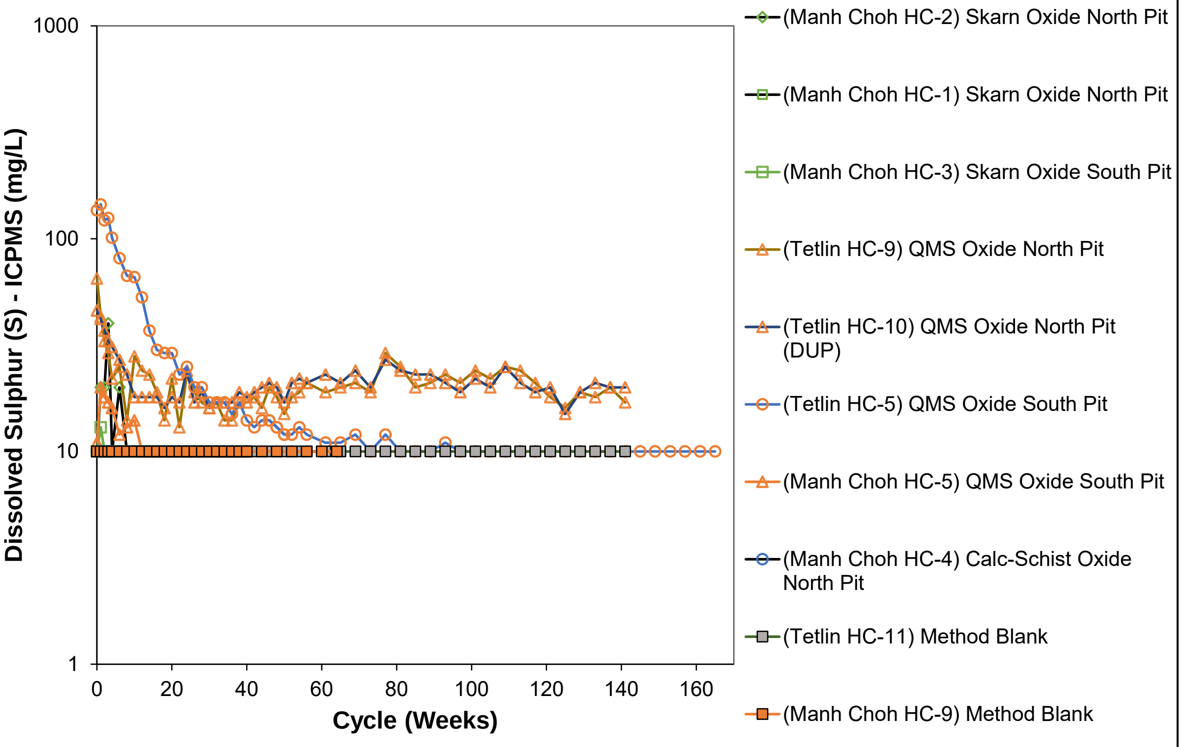

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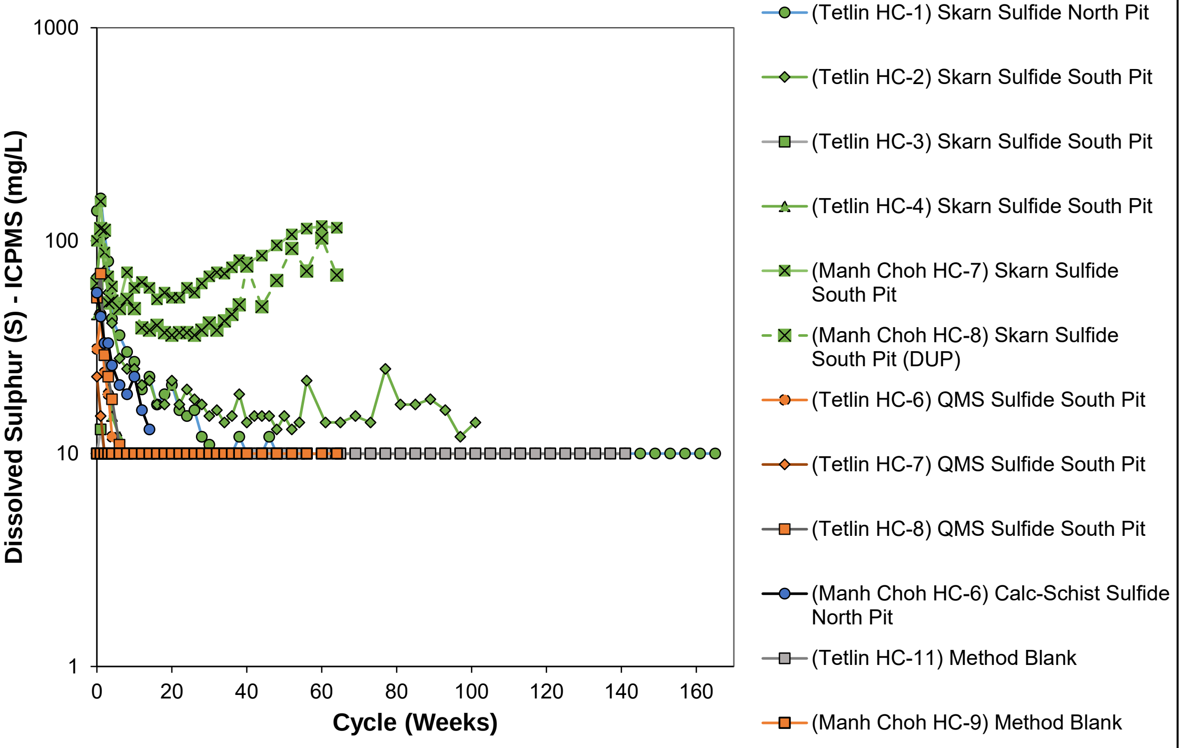

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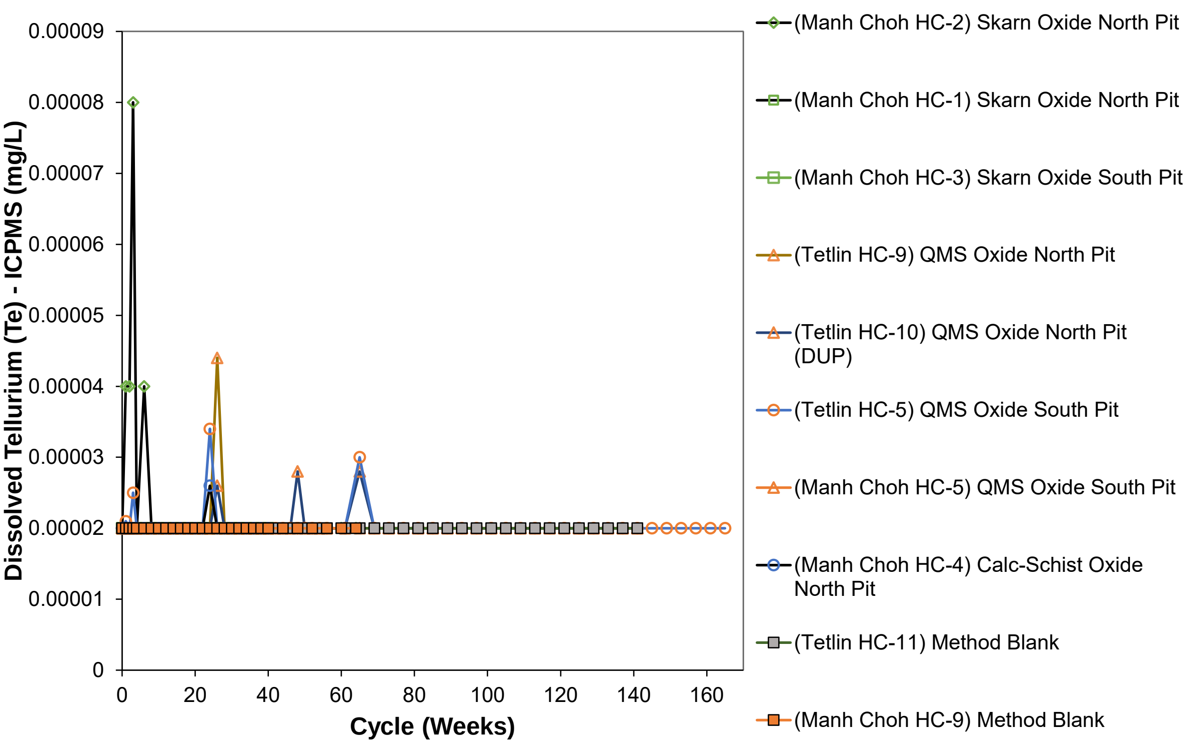

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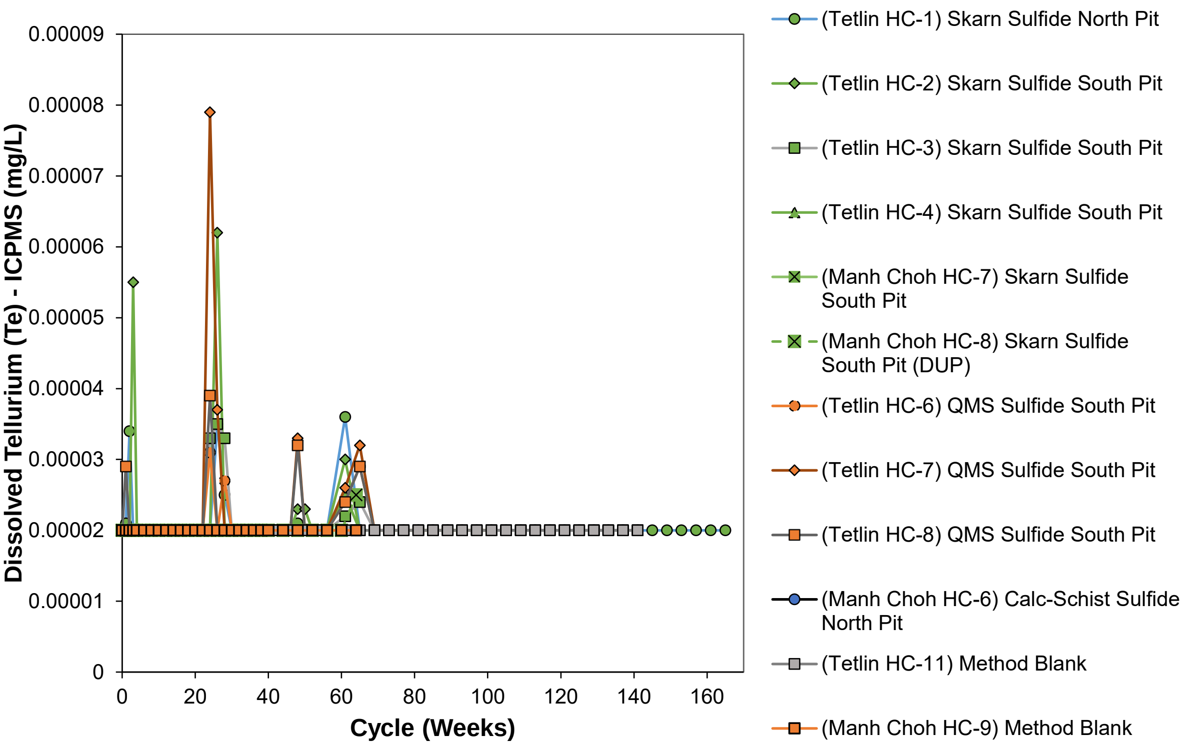

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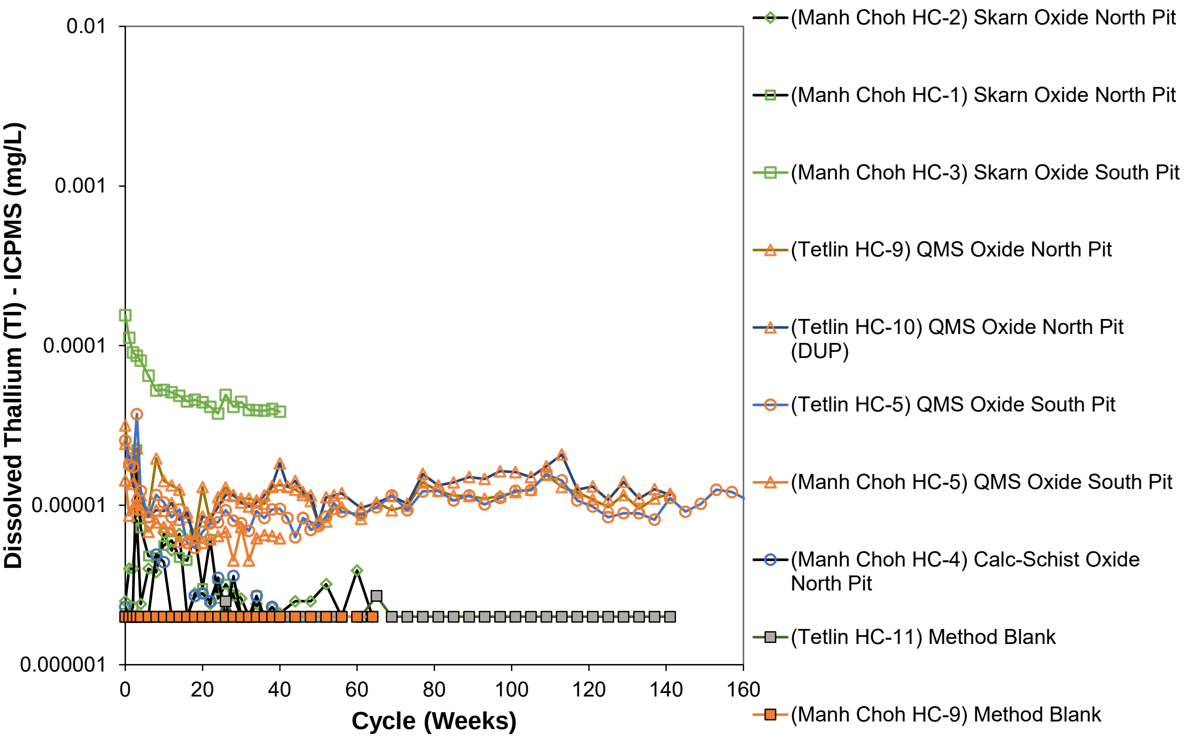

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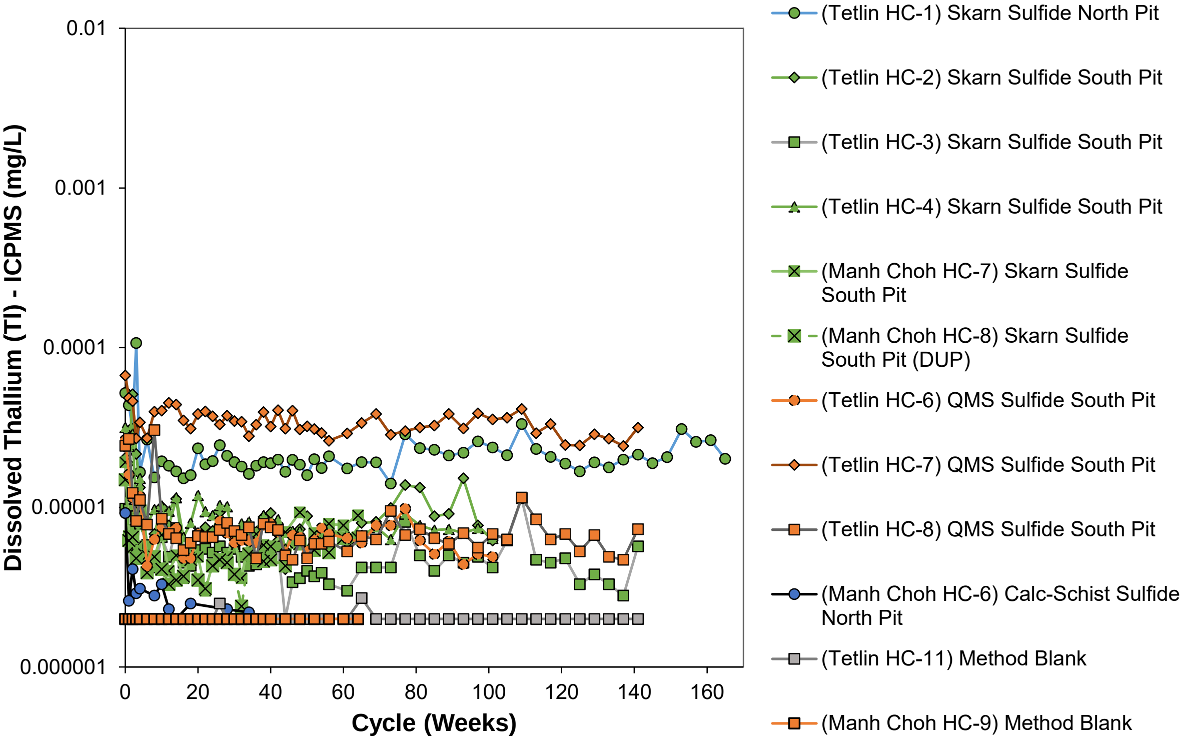

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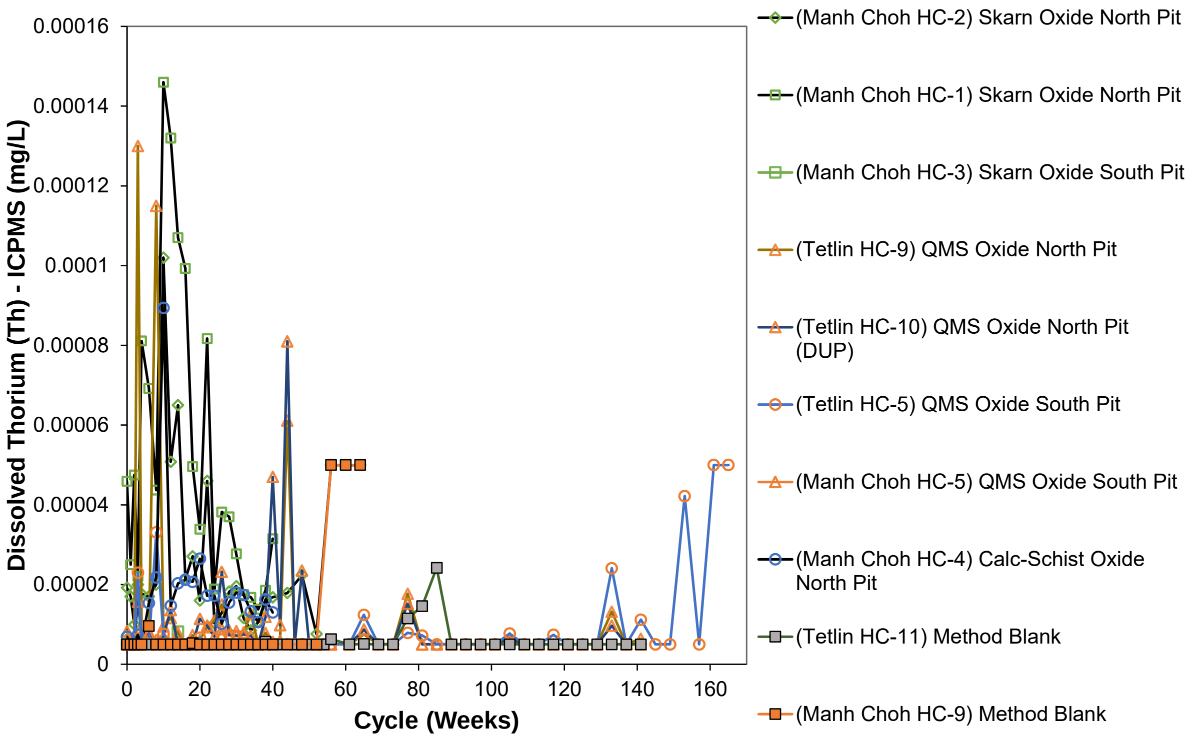

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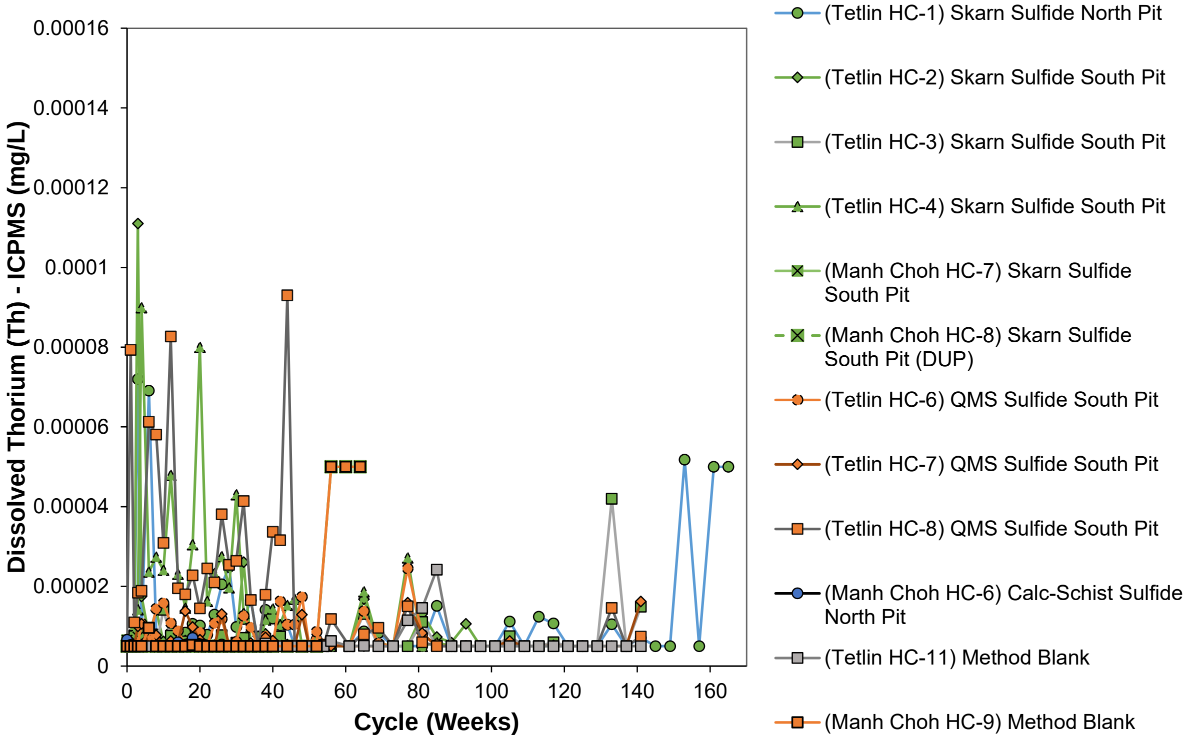

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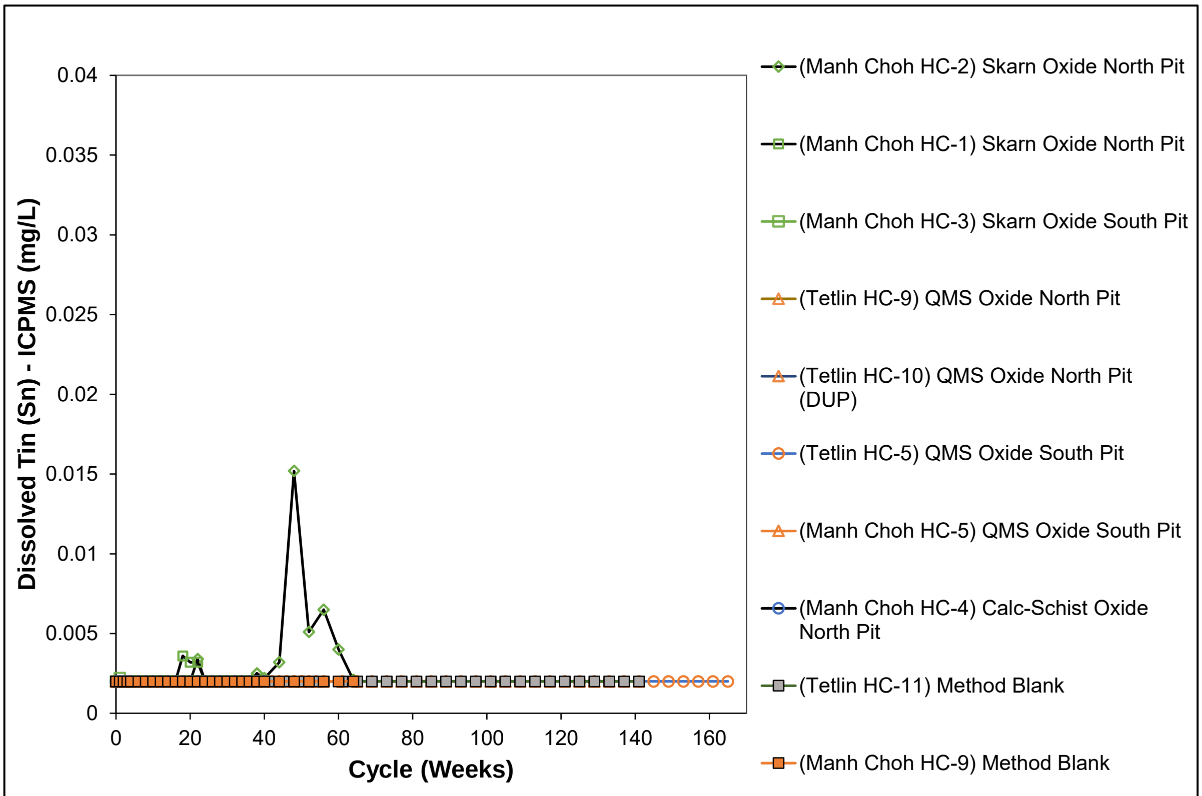

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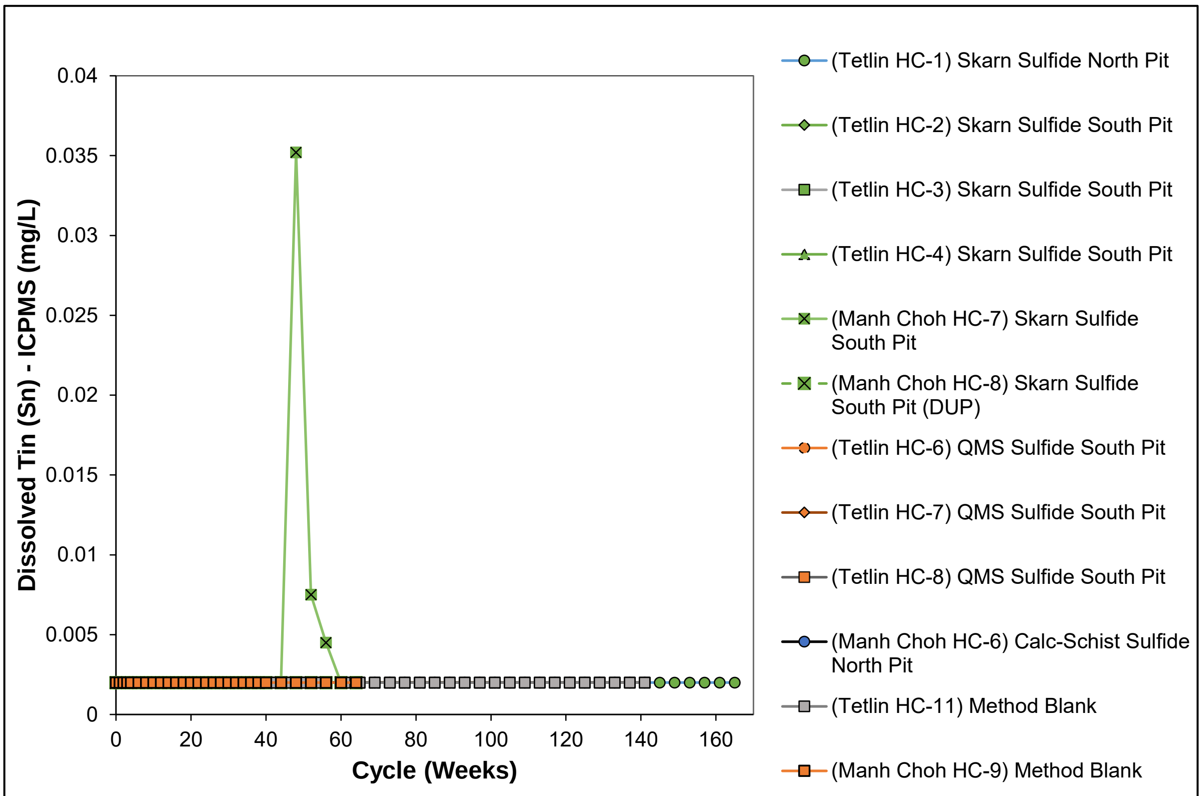

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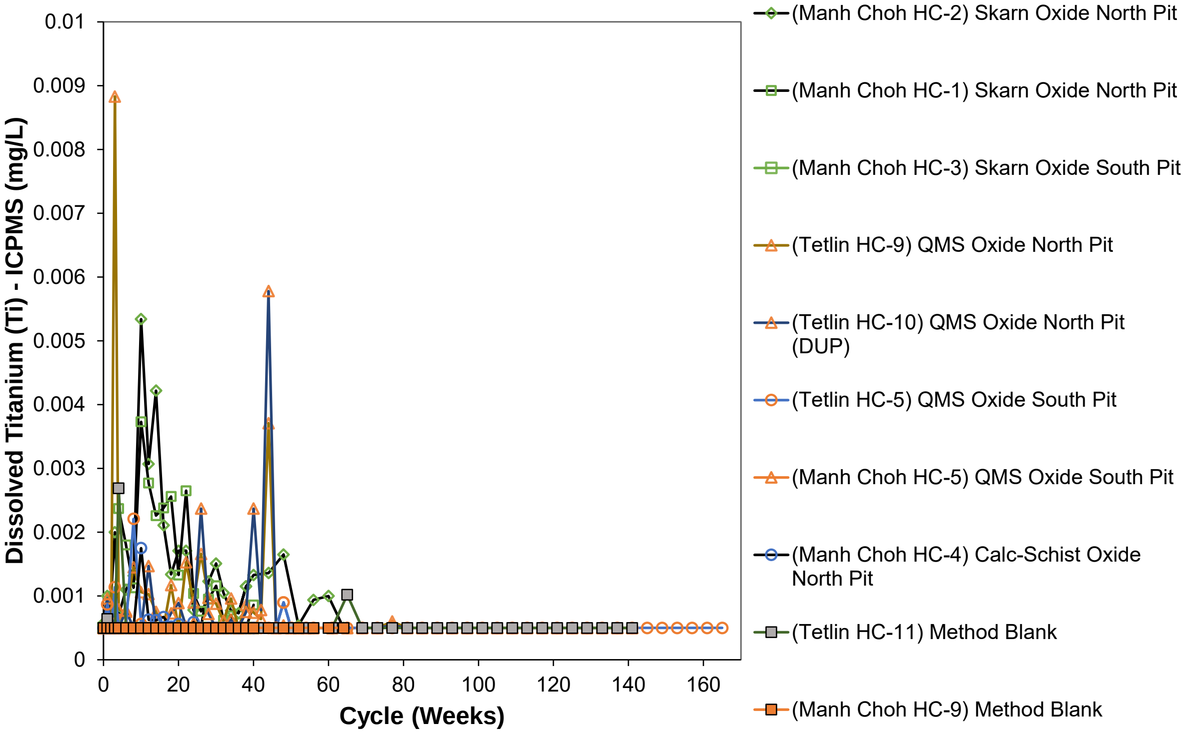

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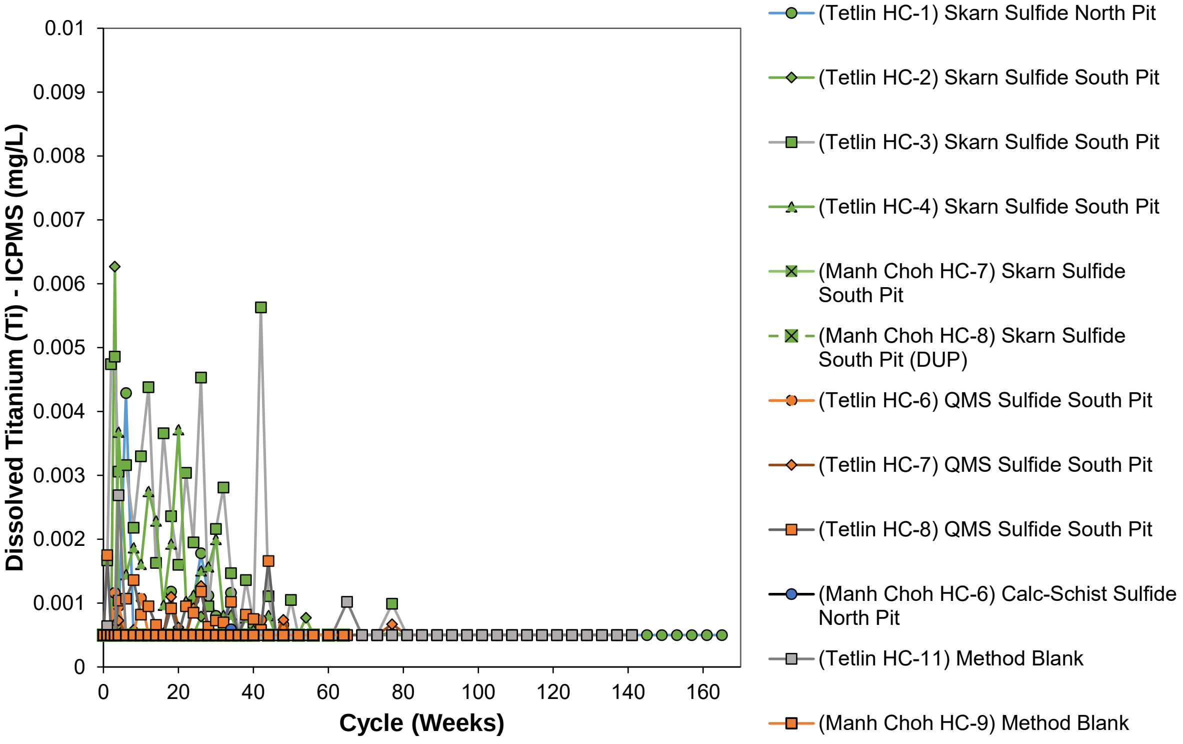

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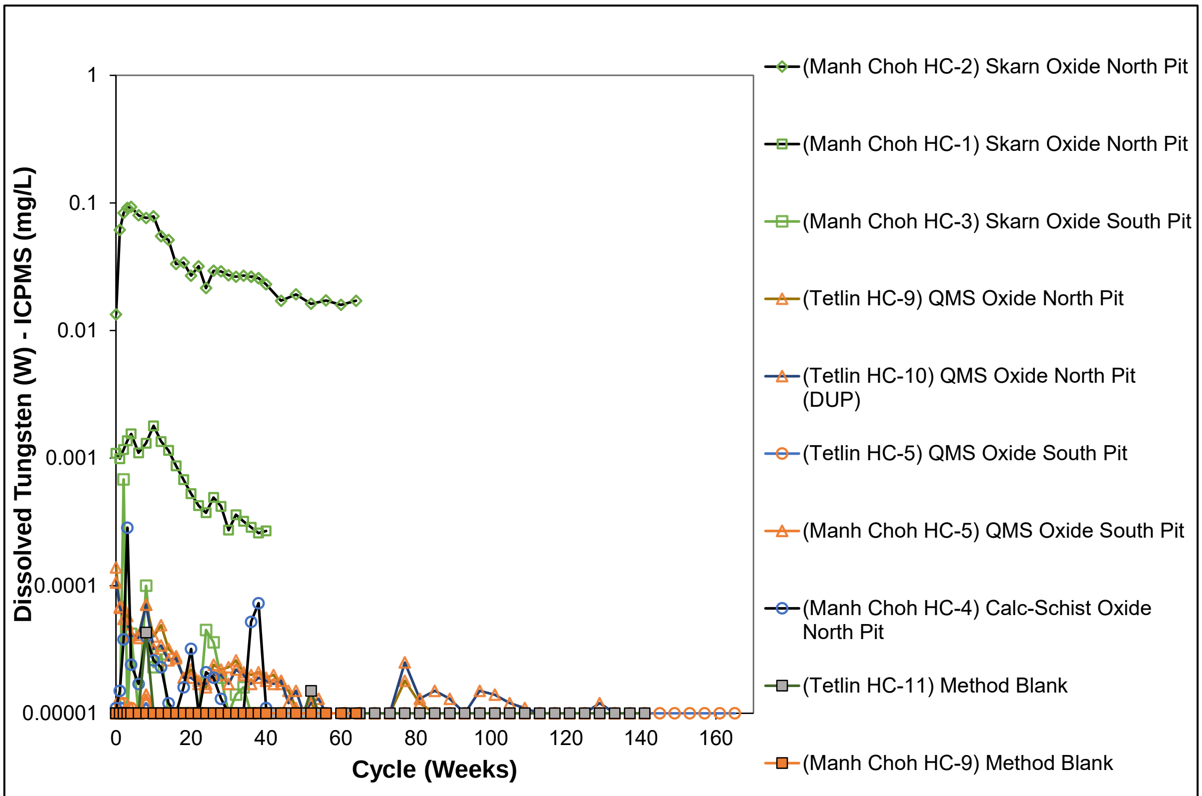

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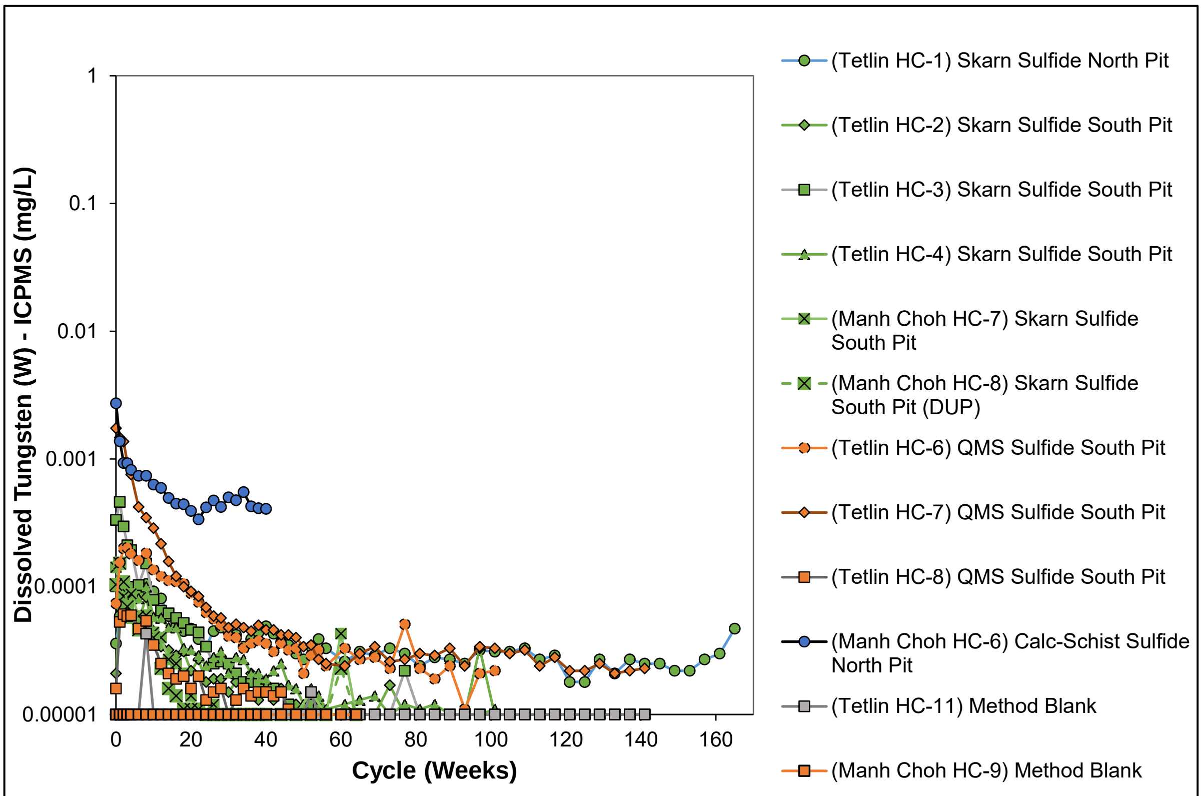

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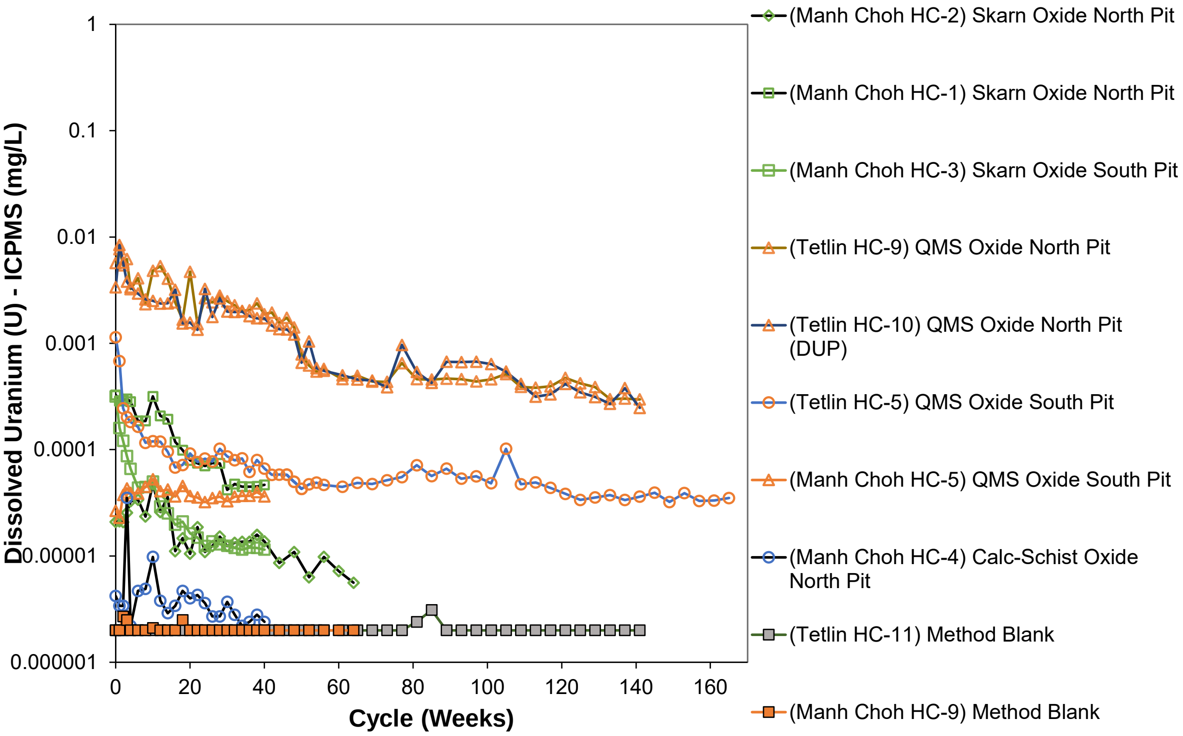

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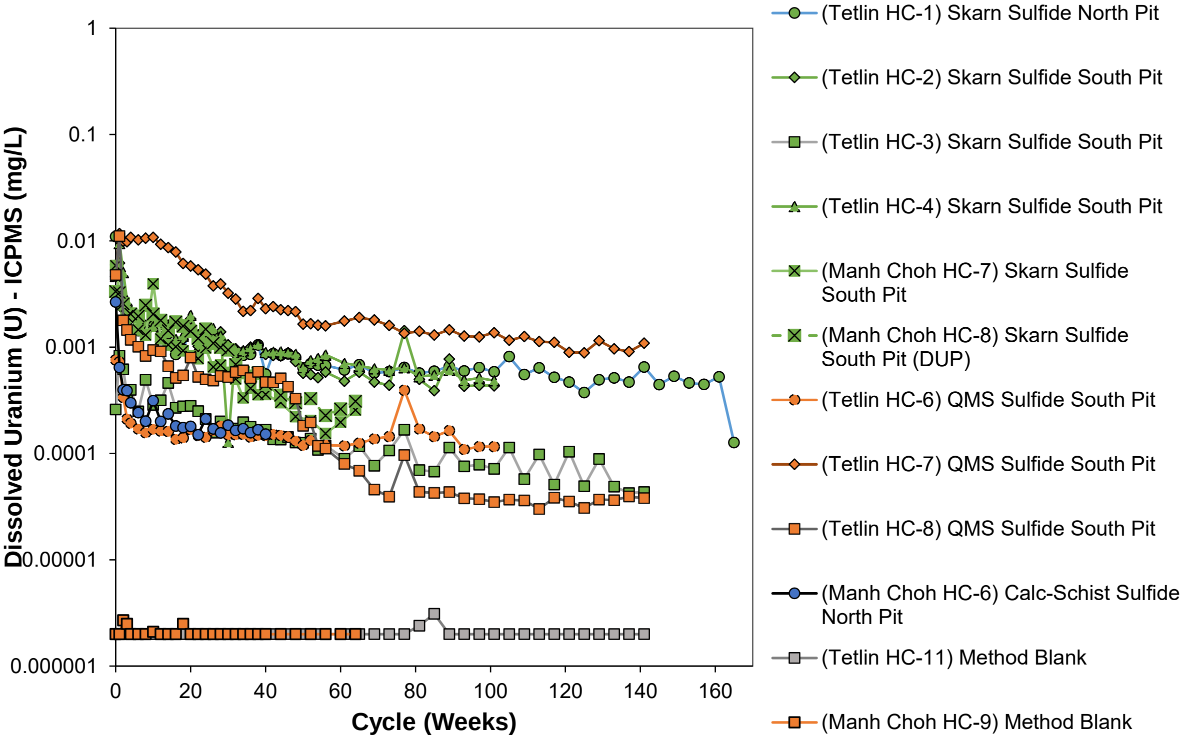

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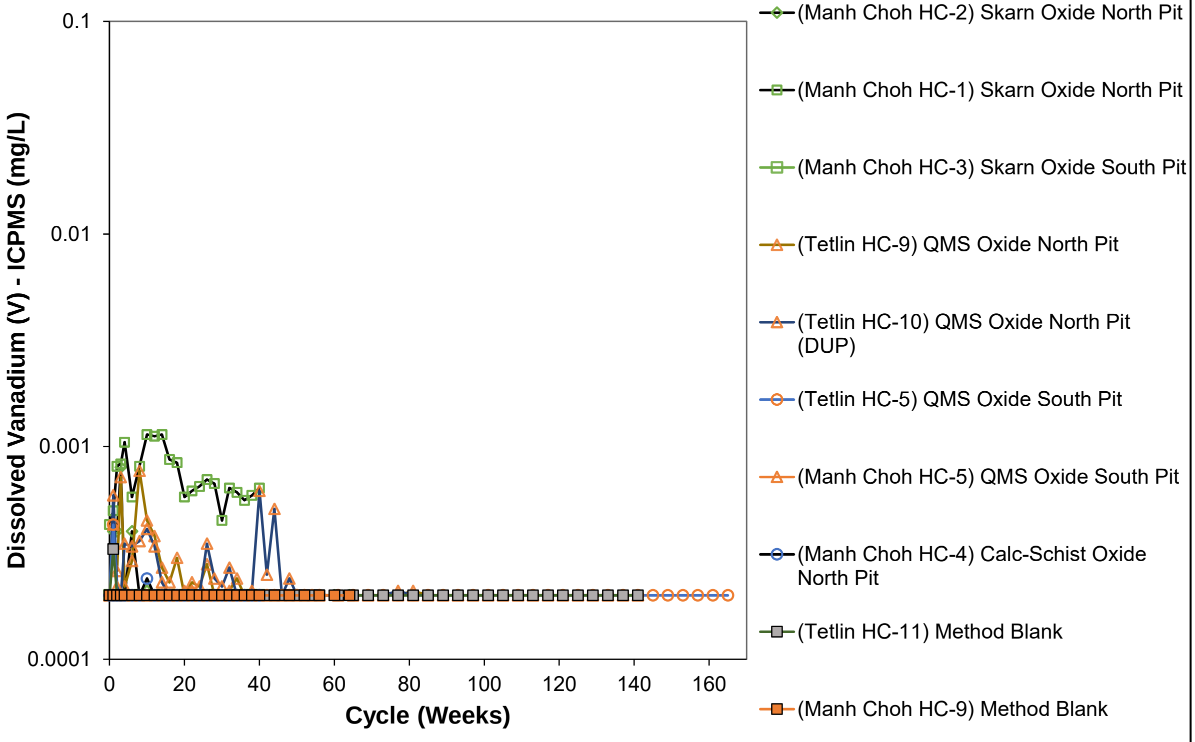

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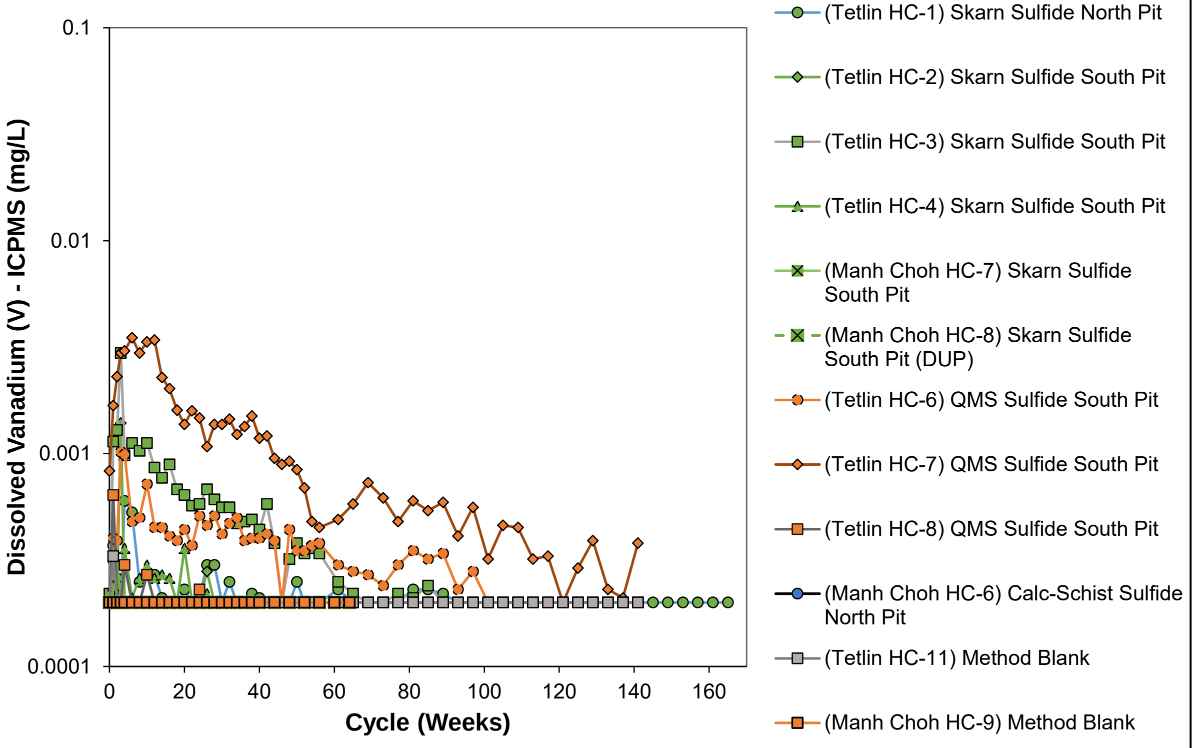

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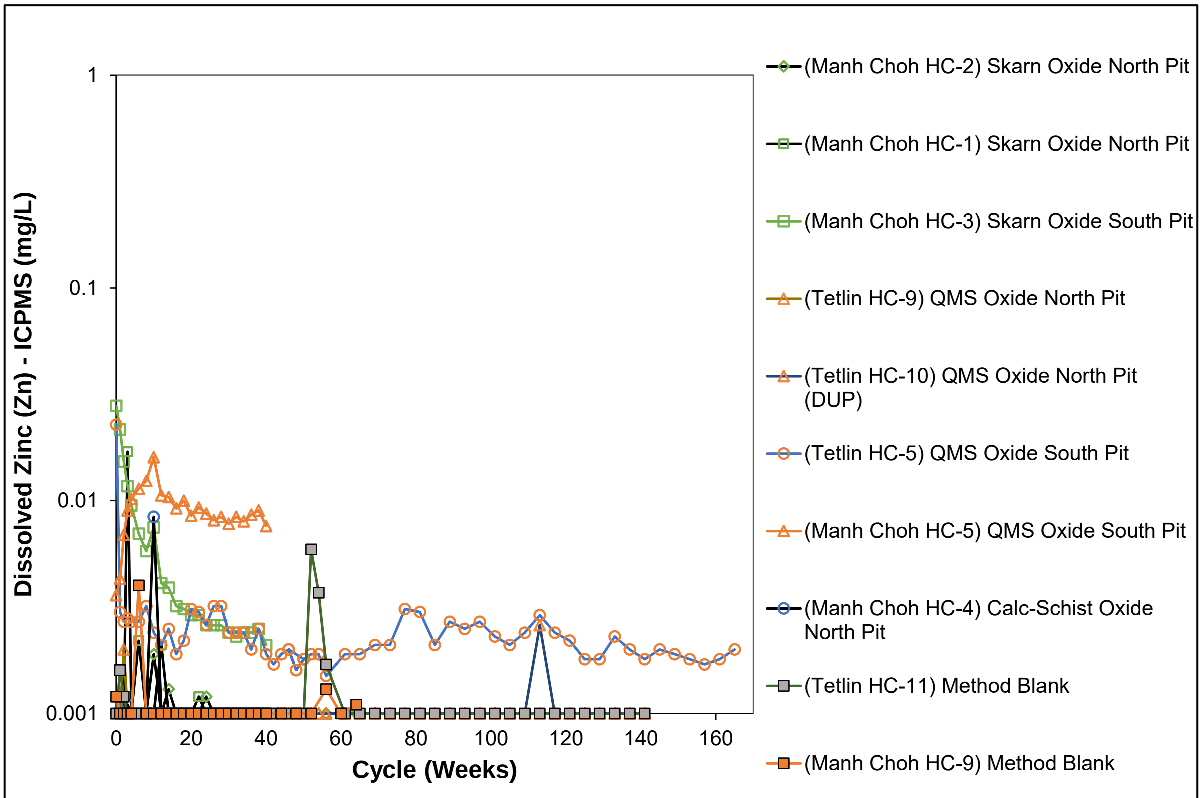

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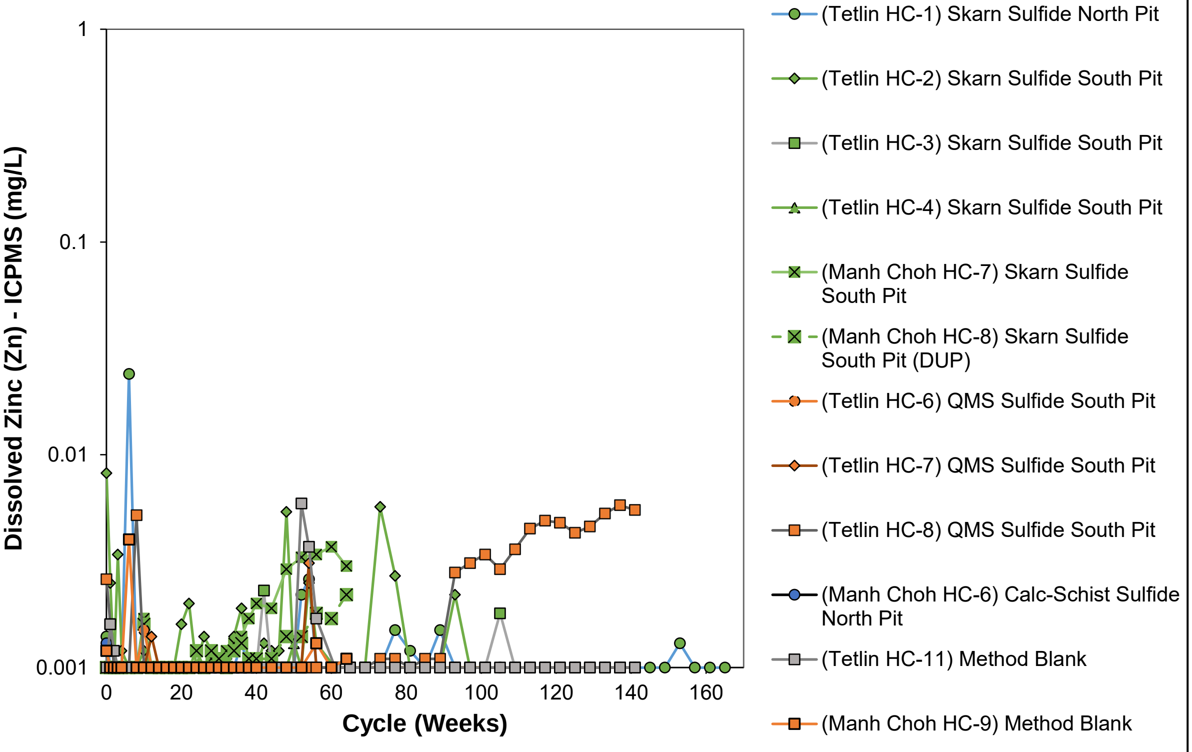

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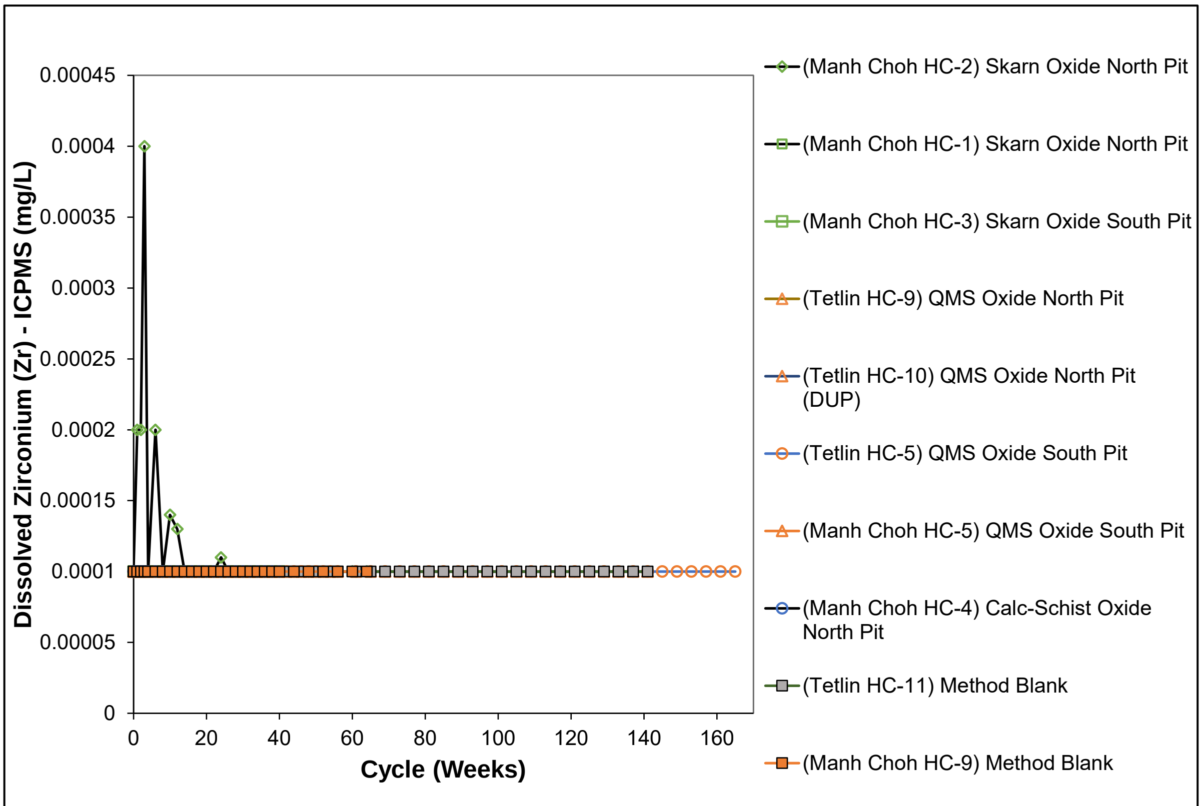

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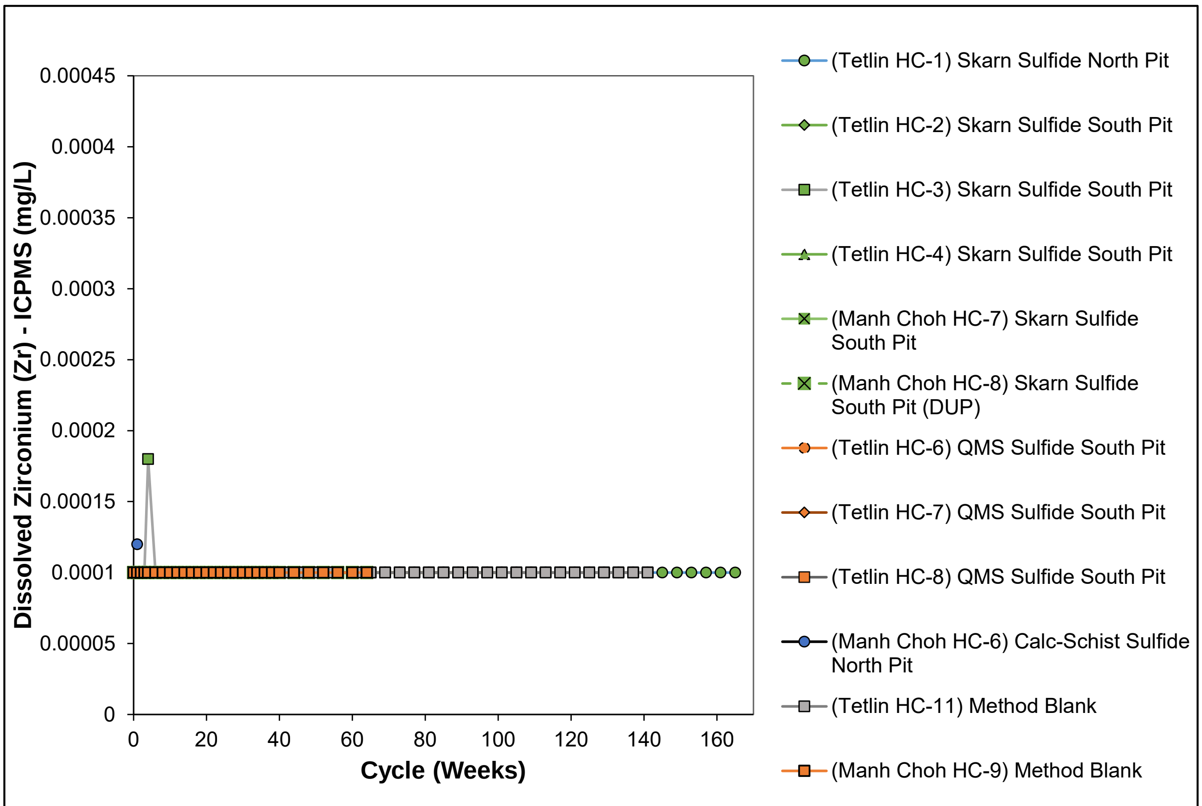

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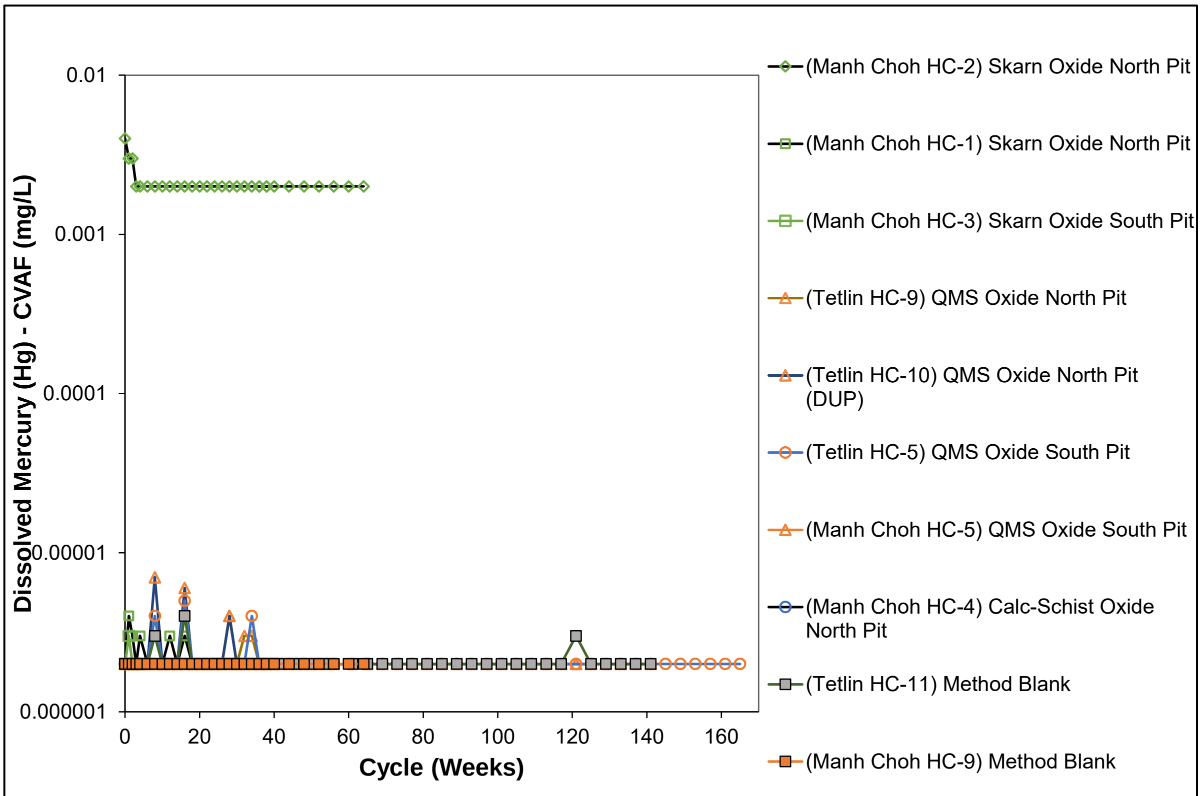

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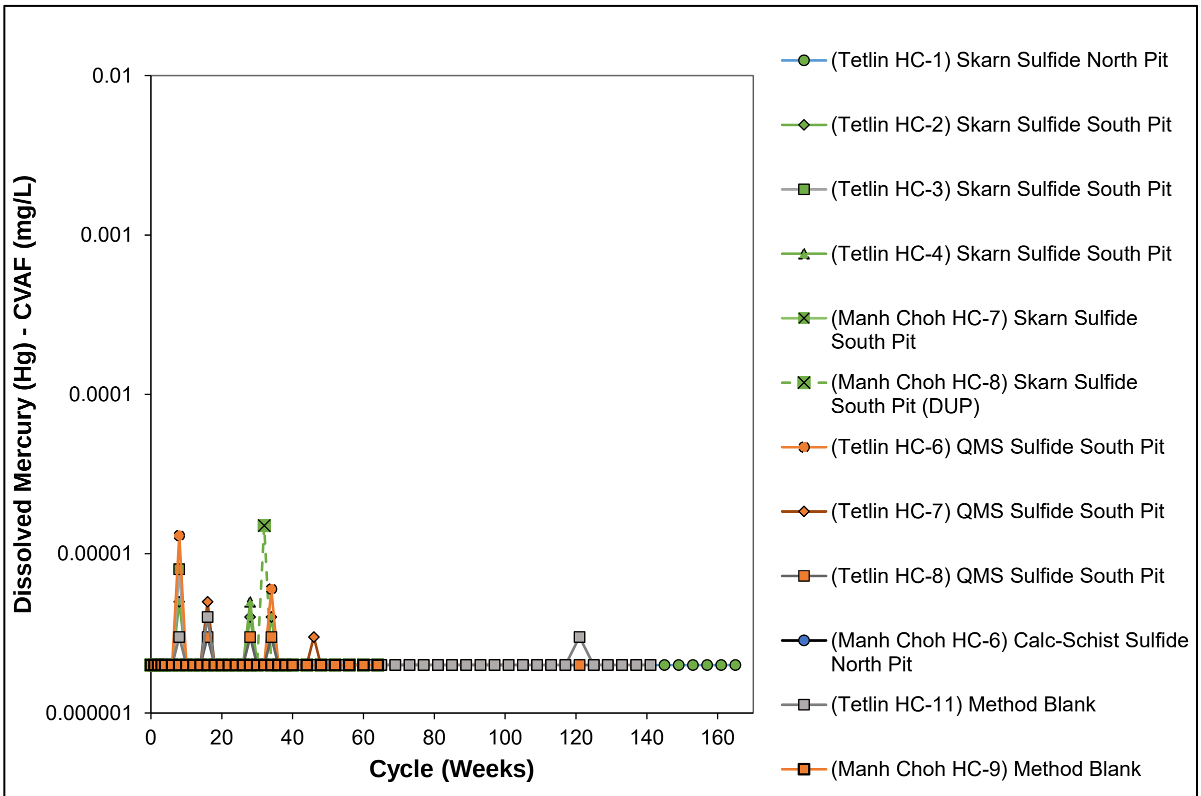

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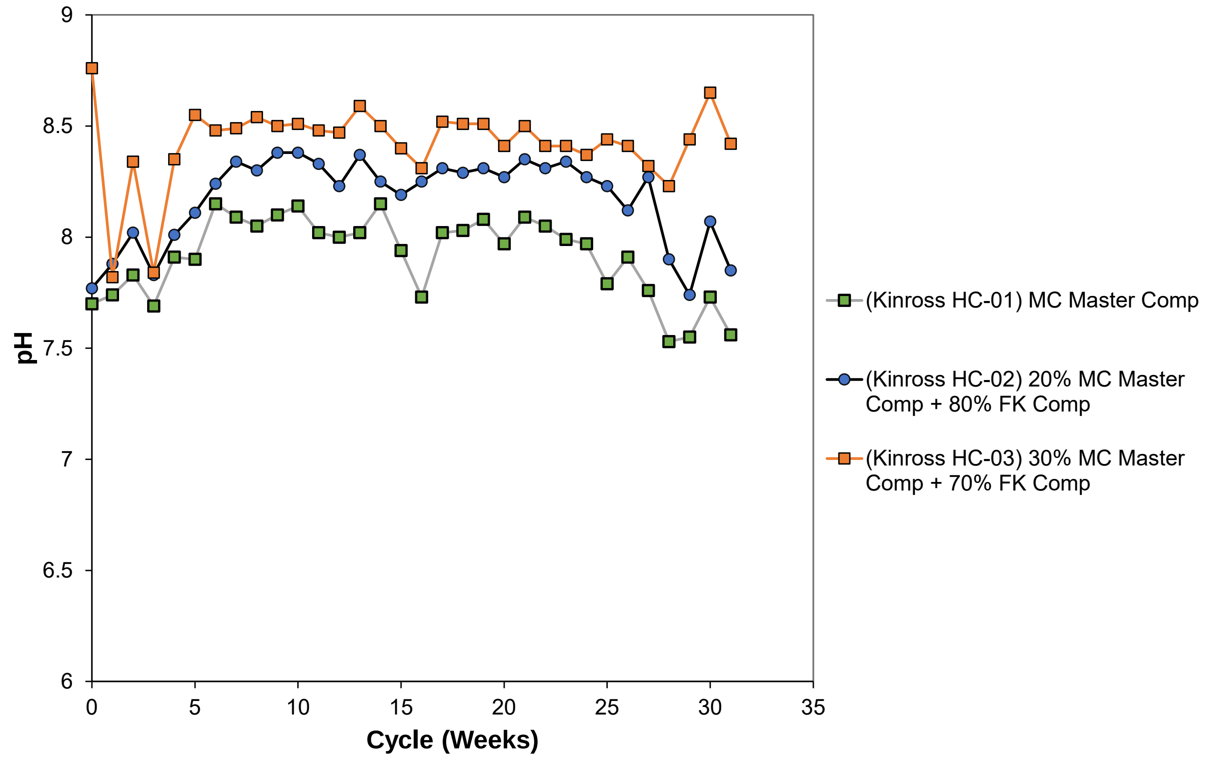
Appendix B2: Humidity Cell Charts Ore Samples



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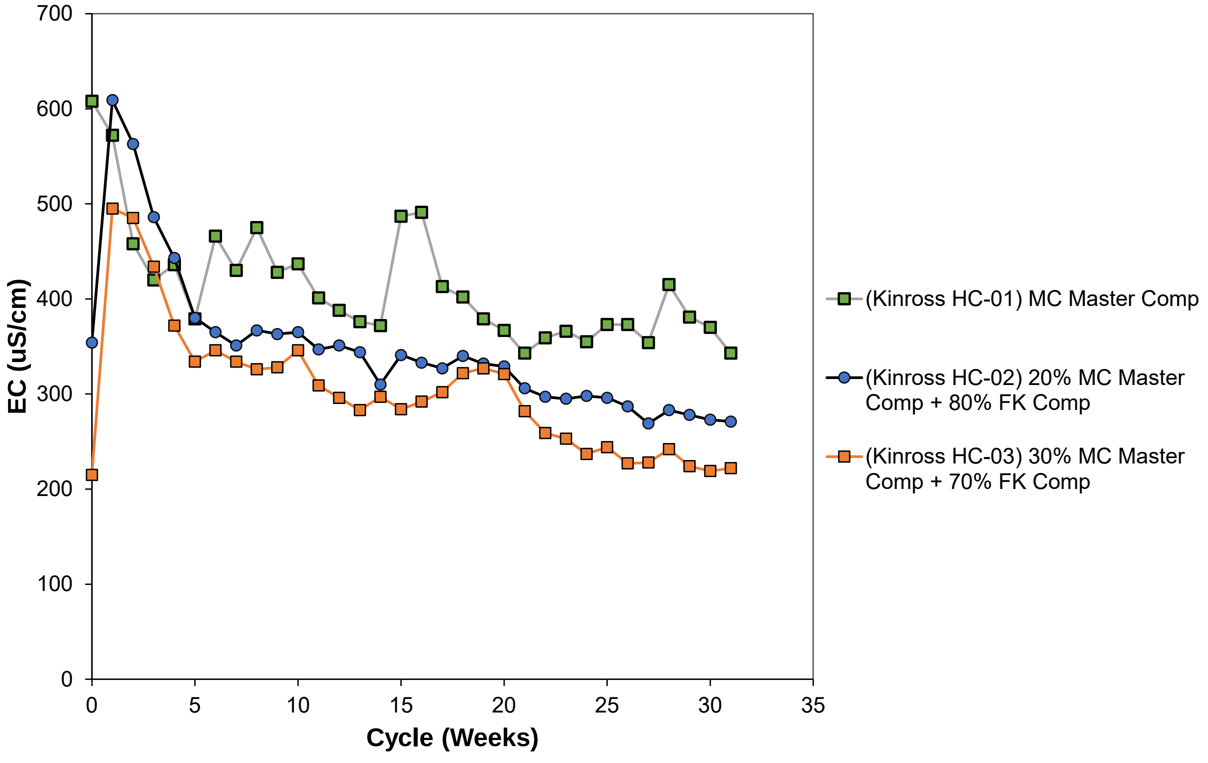

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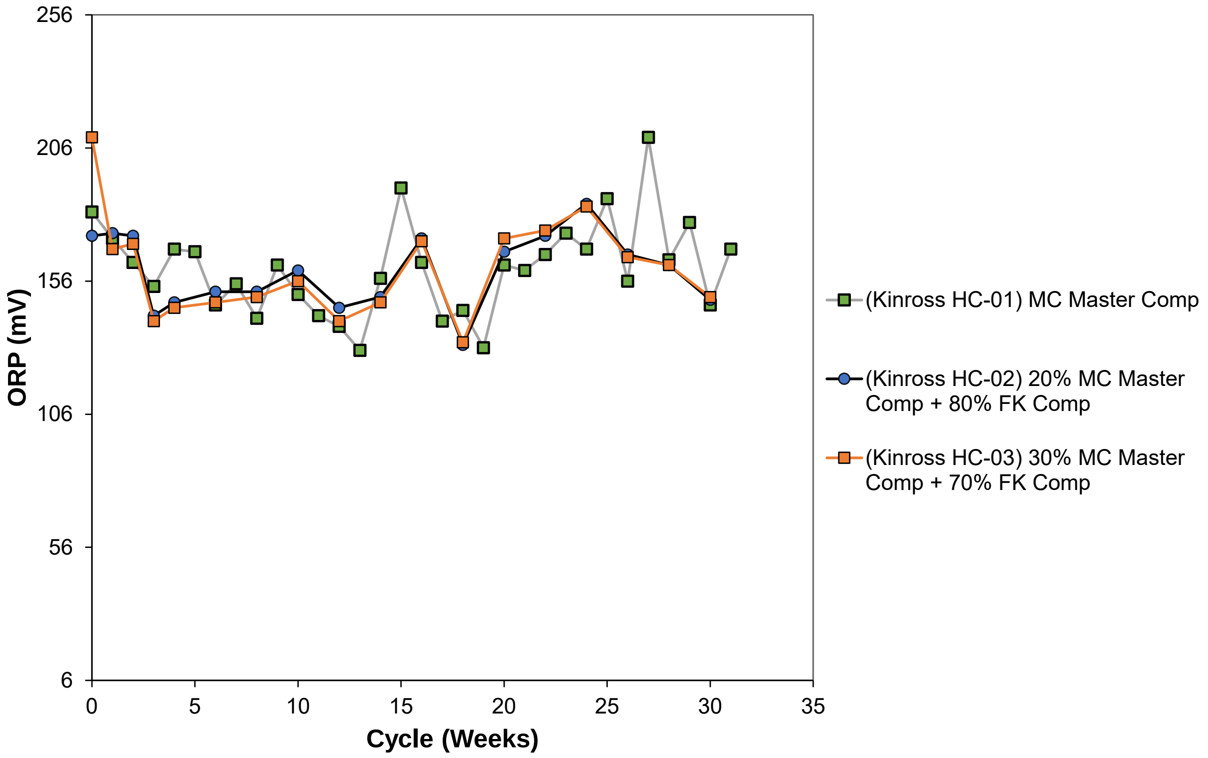

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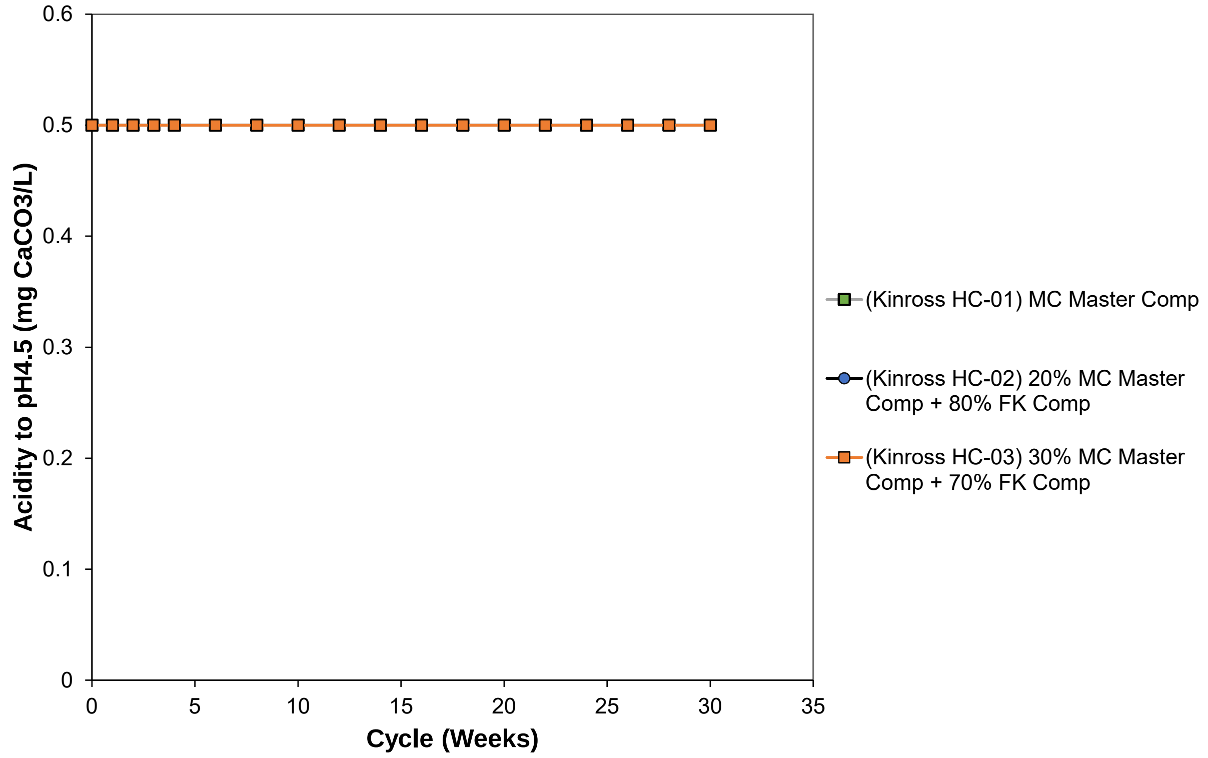

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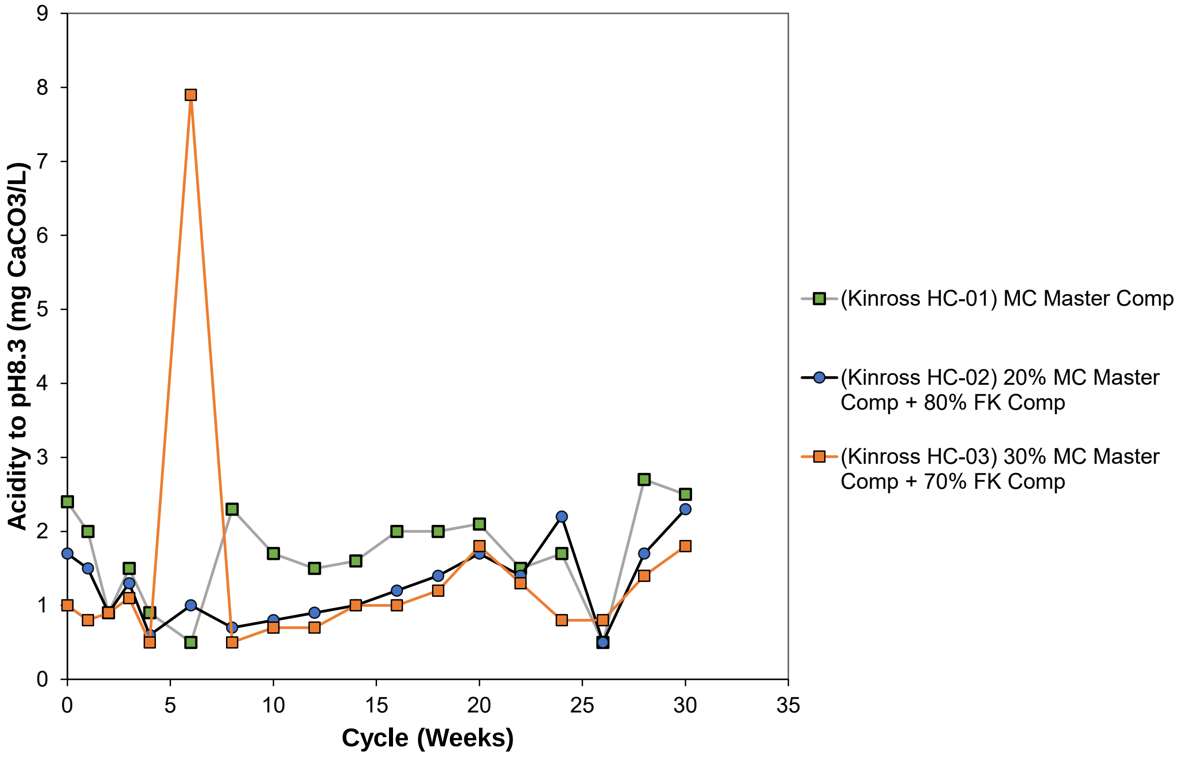

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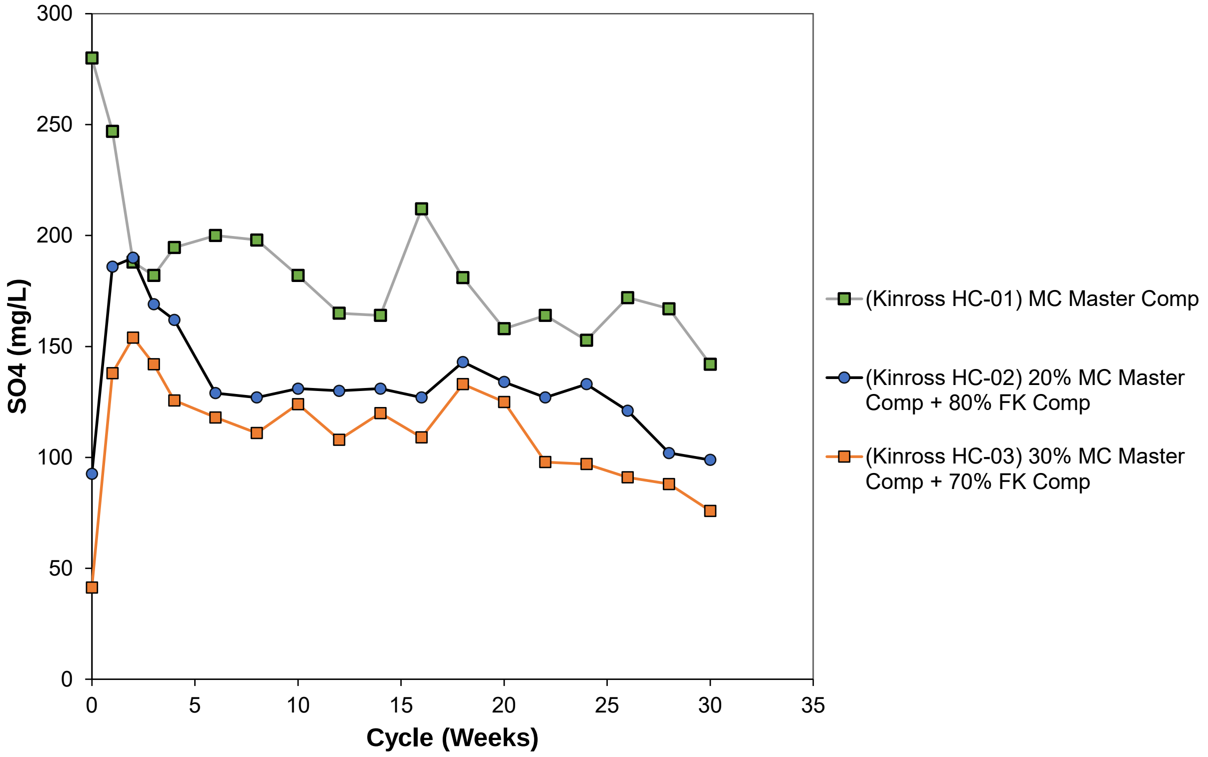

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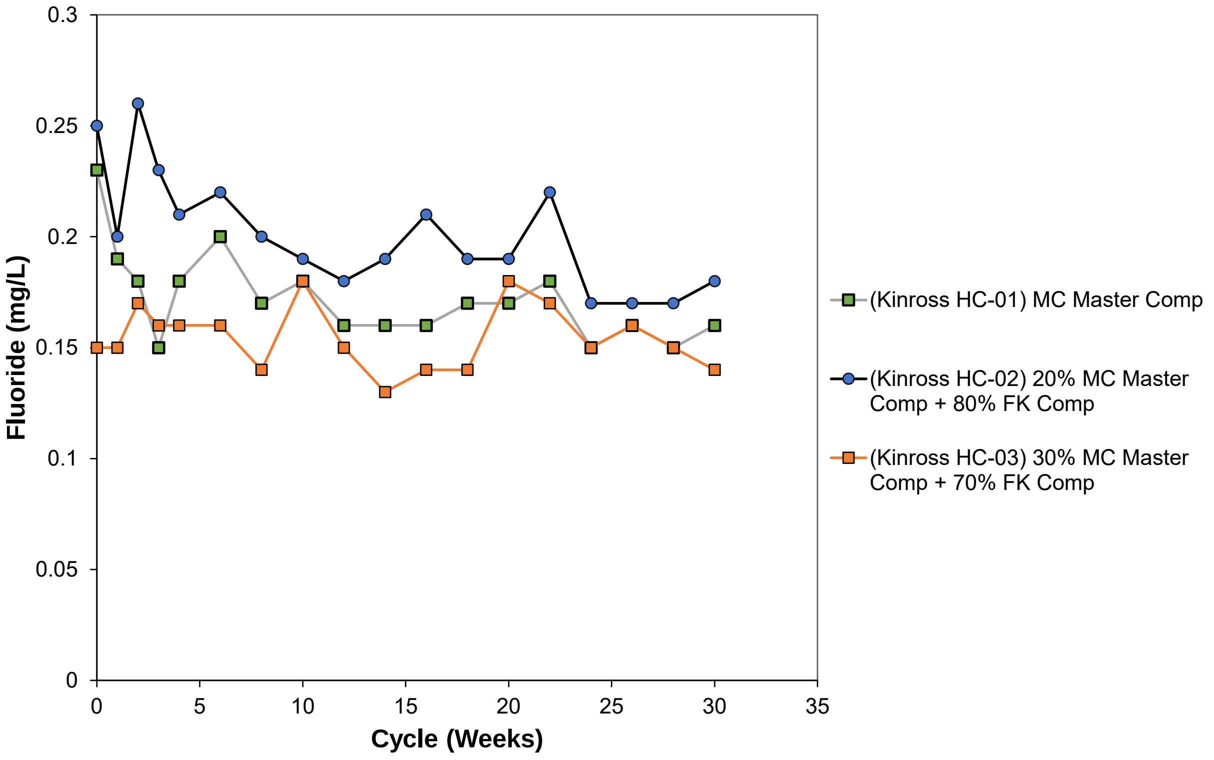

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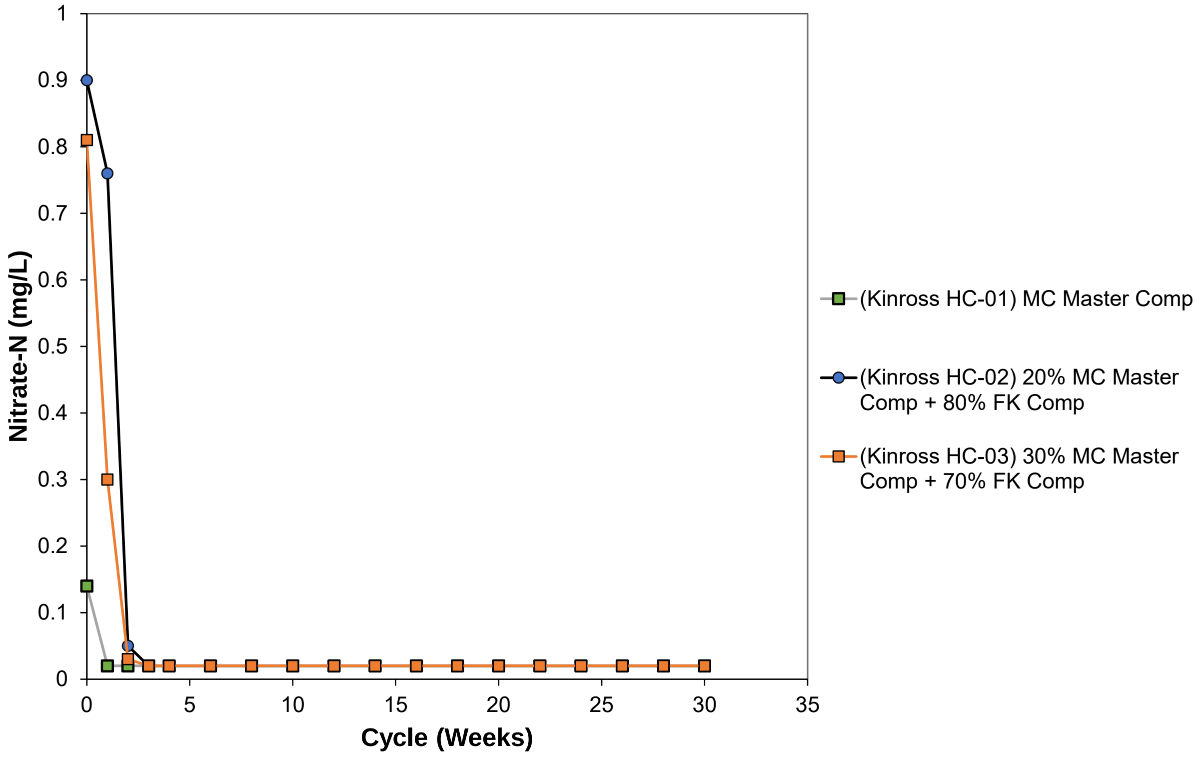

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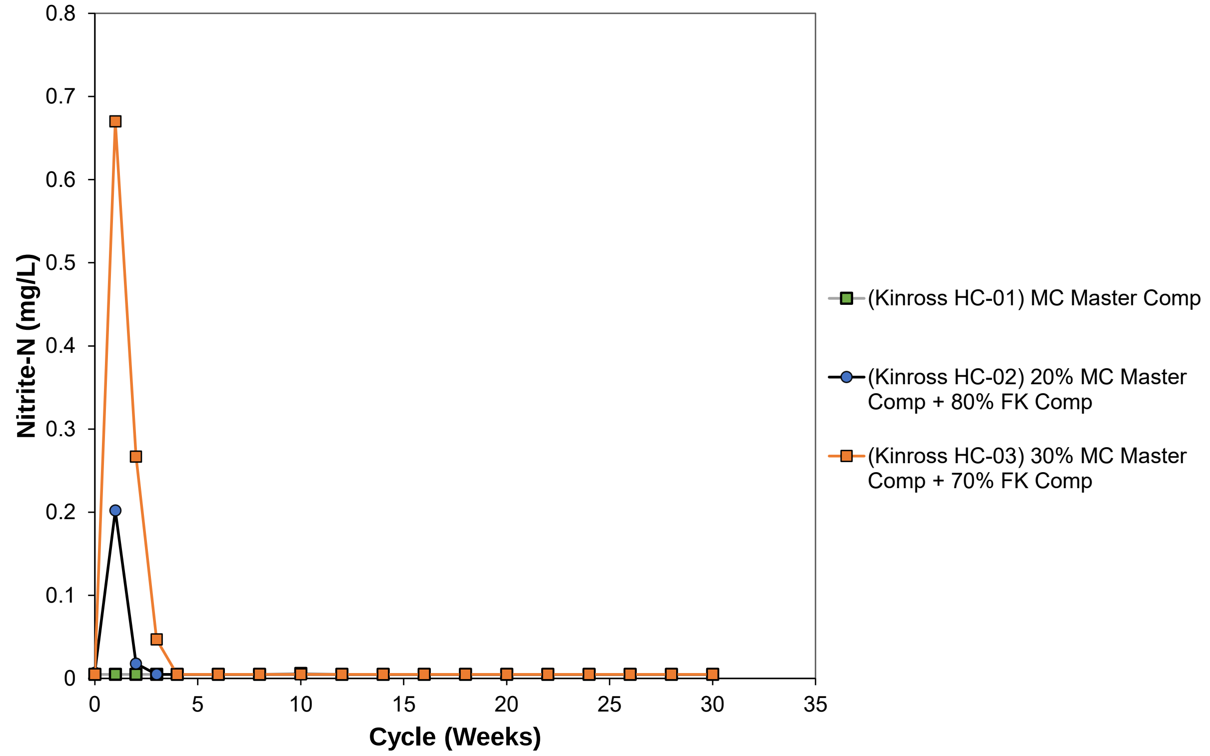

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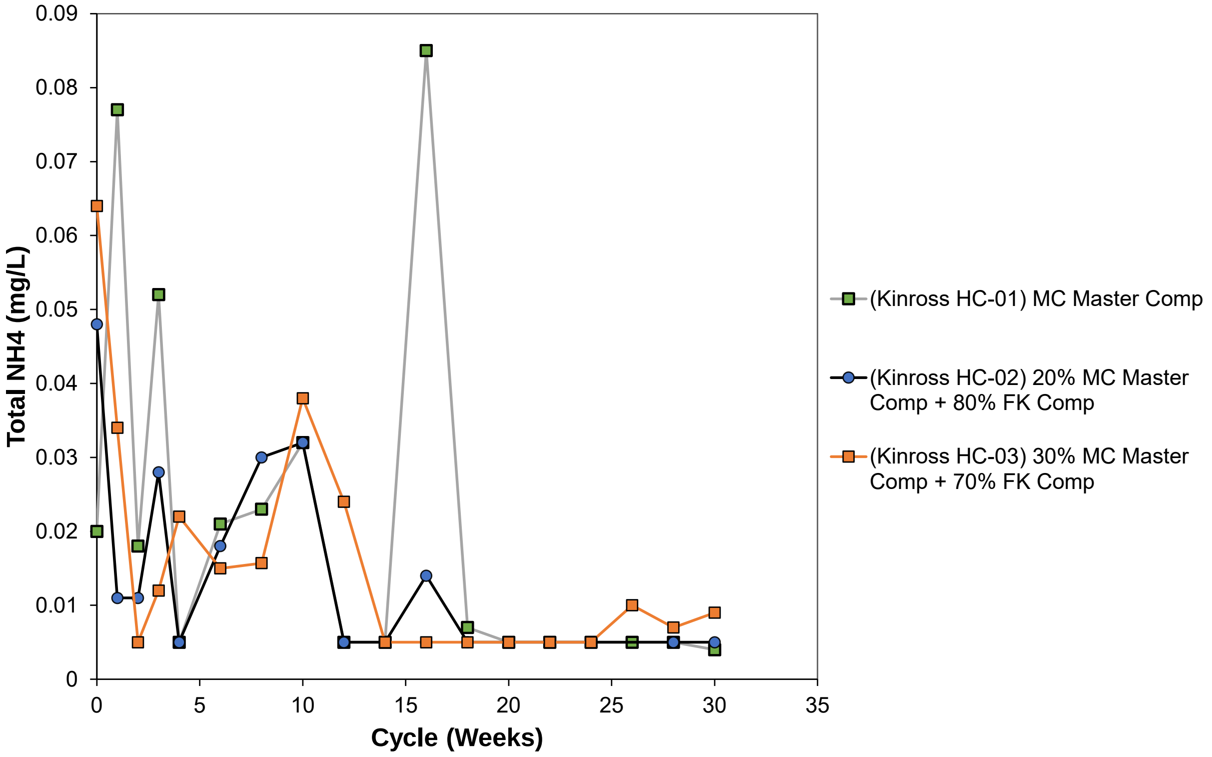

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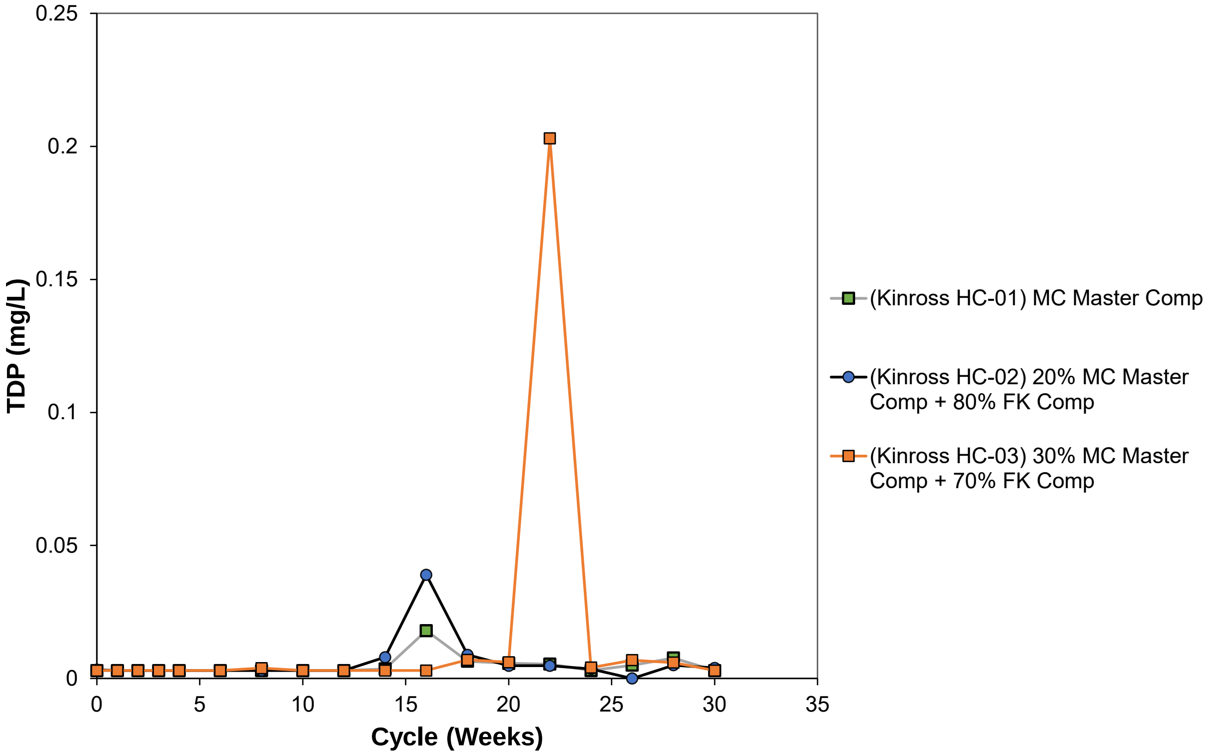

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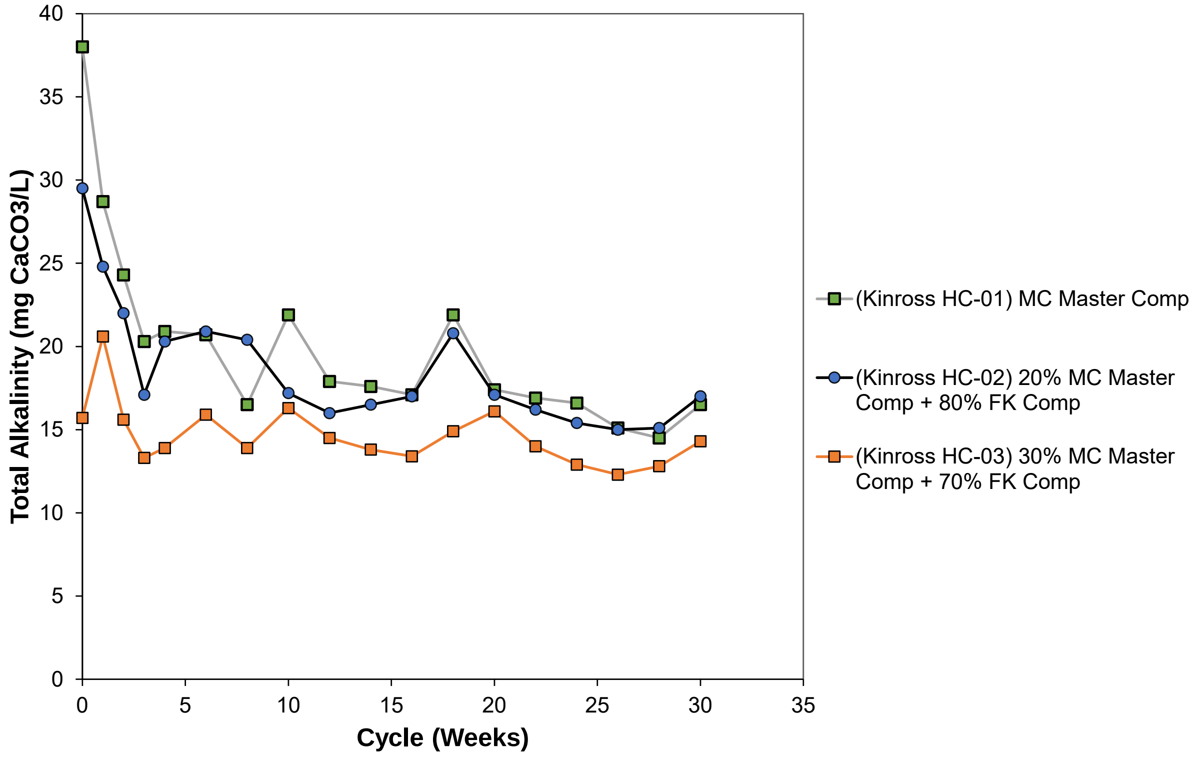

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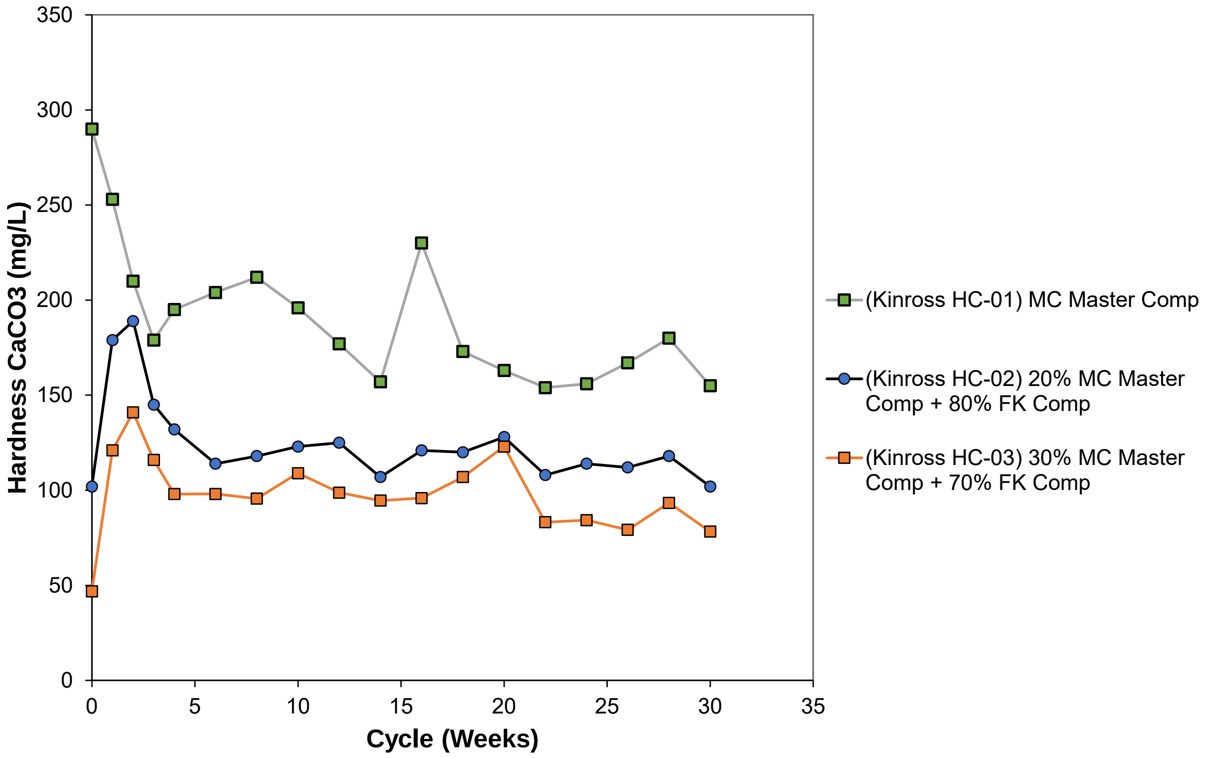

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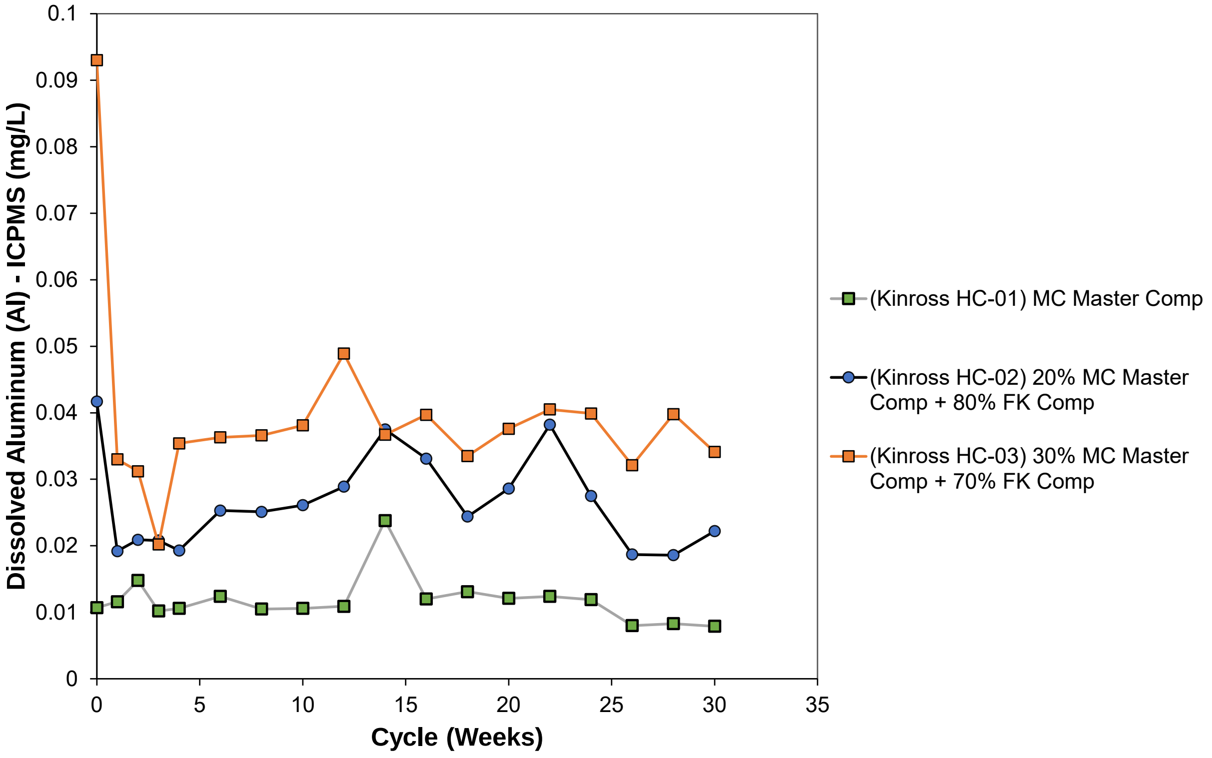

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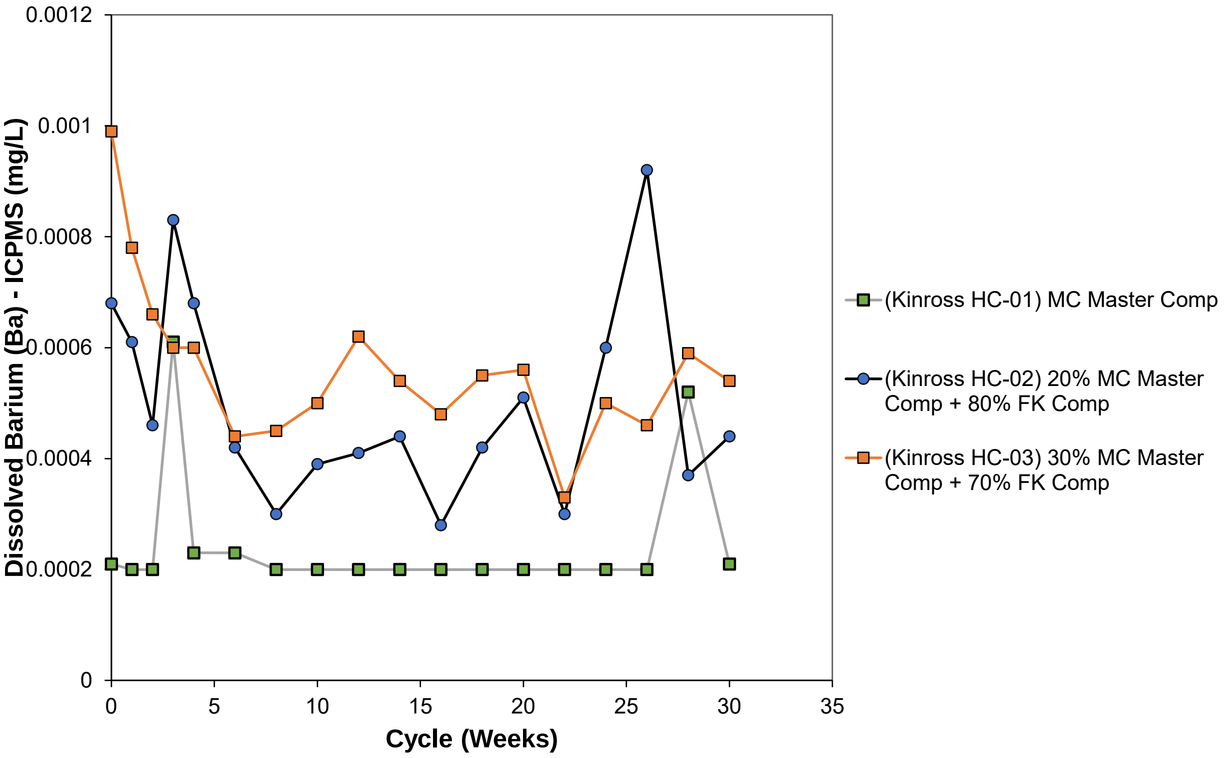

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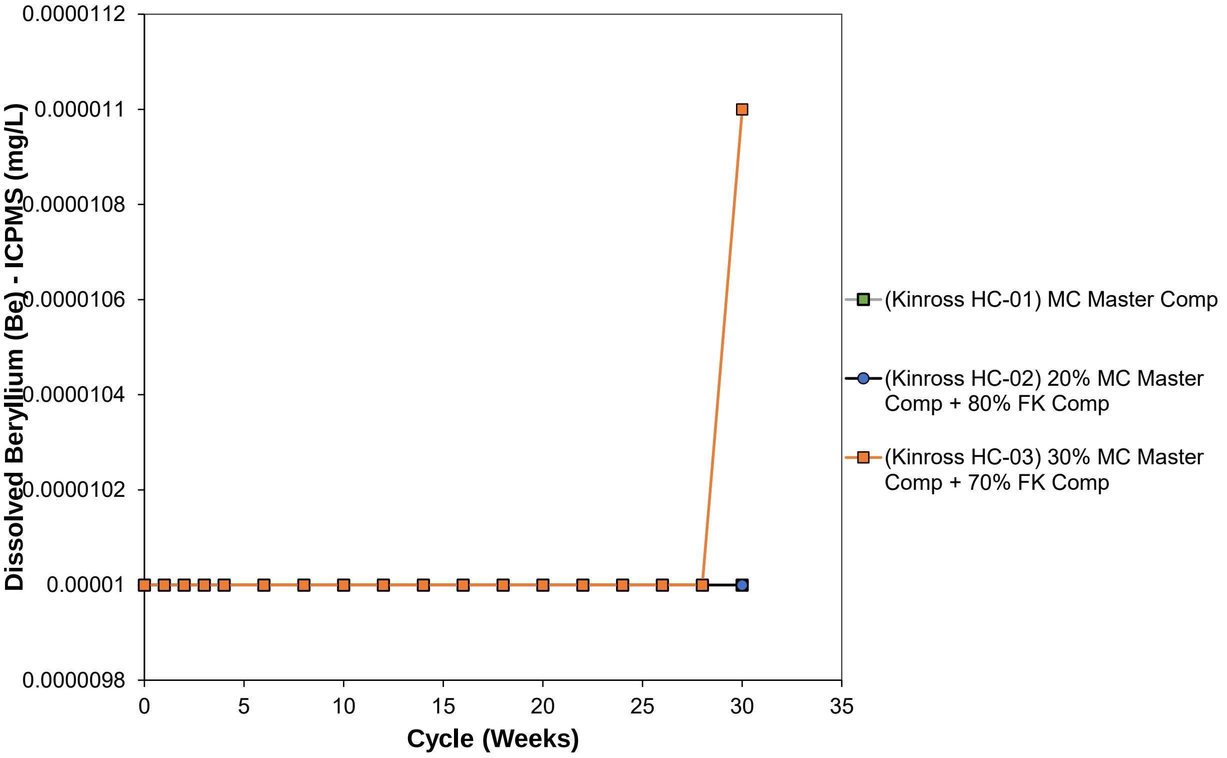

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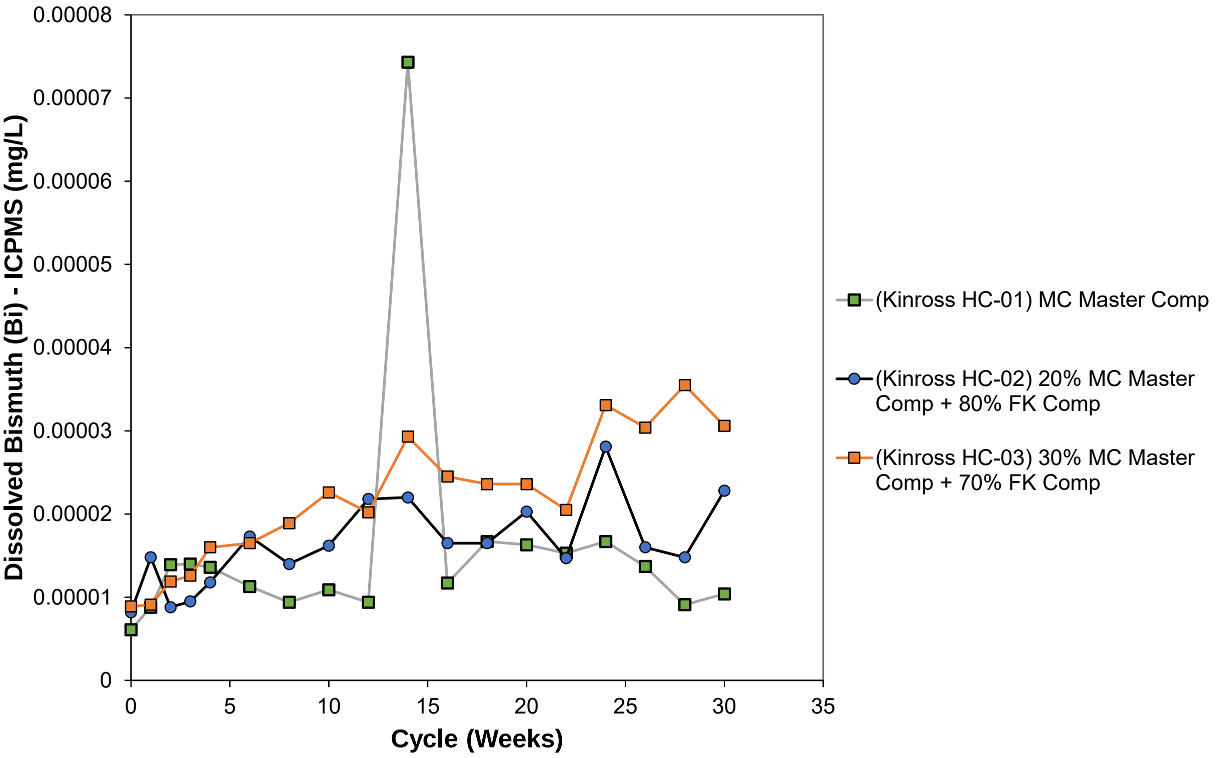

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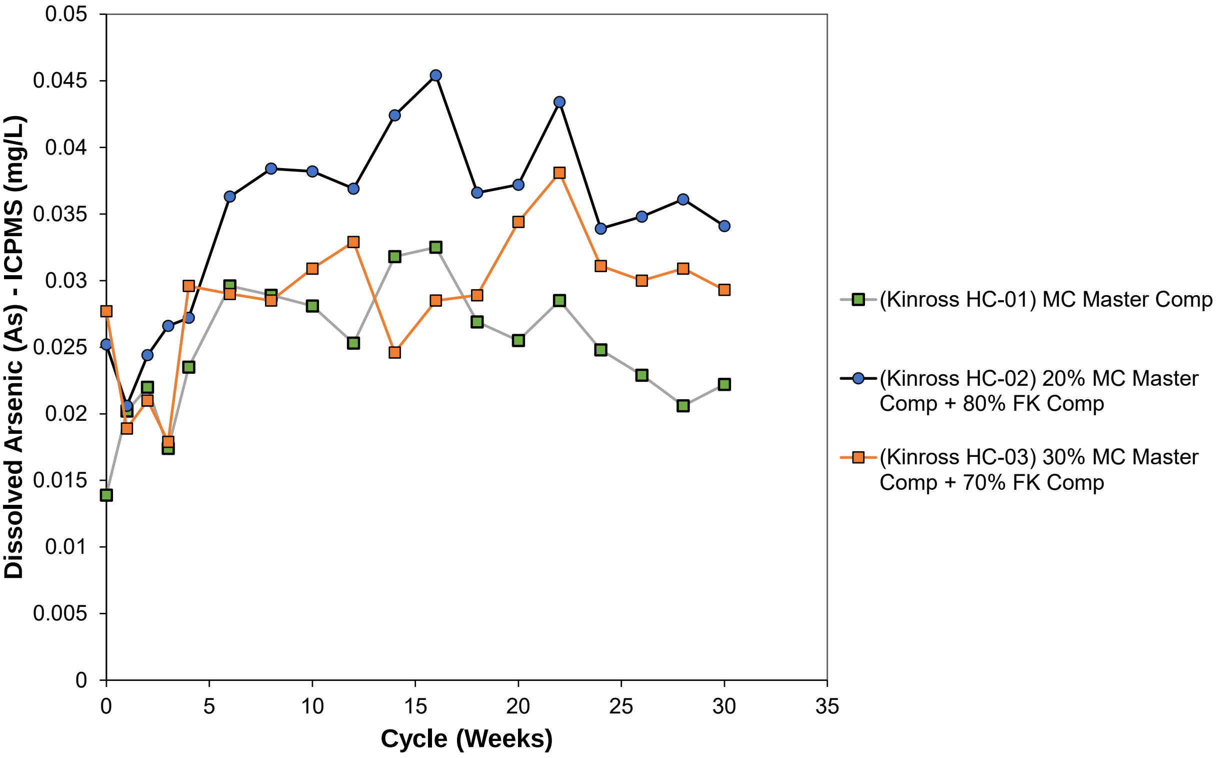

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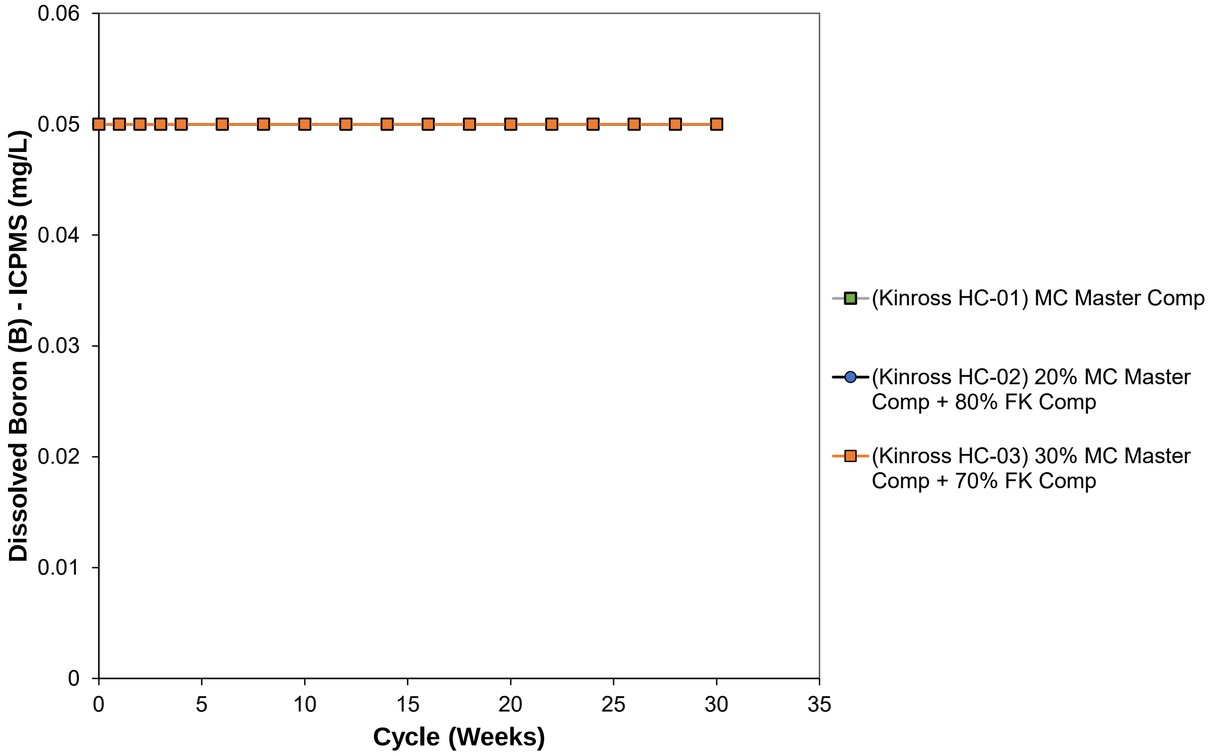

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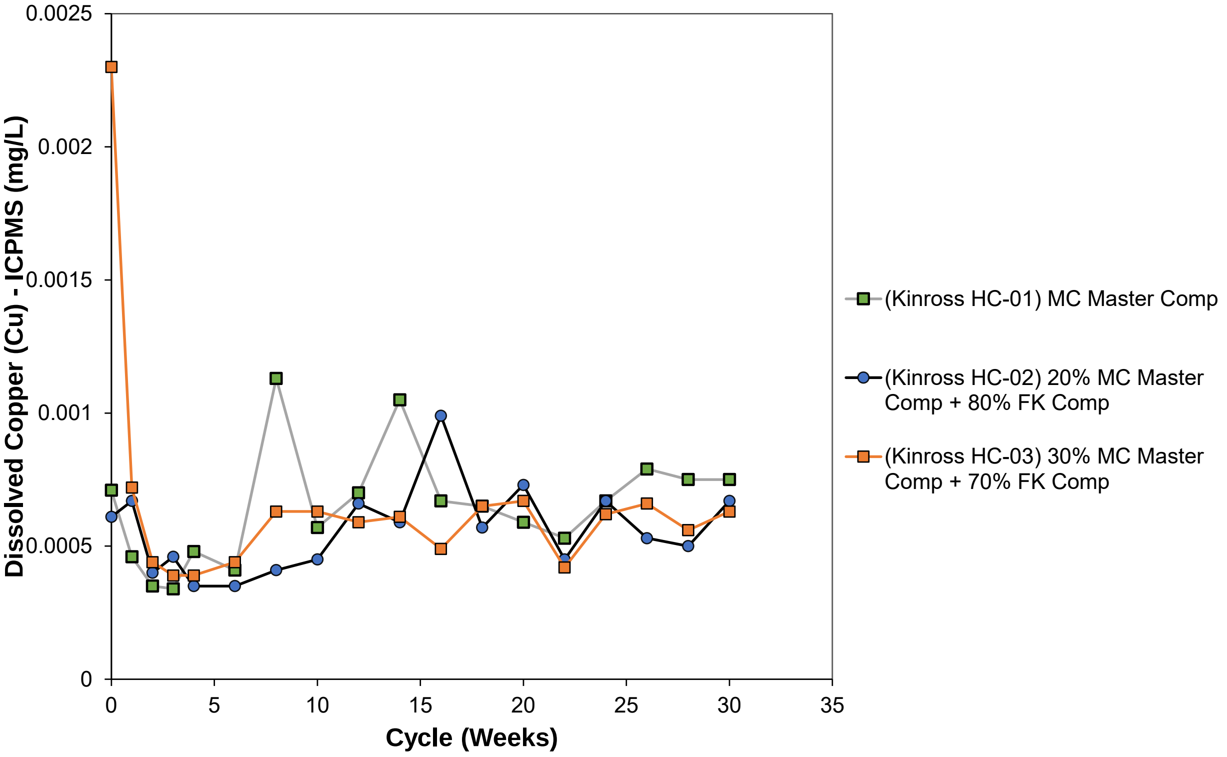

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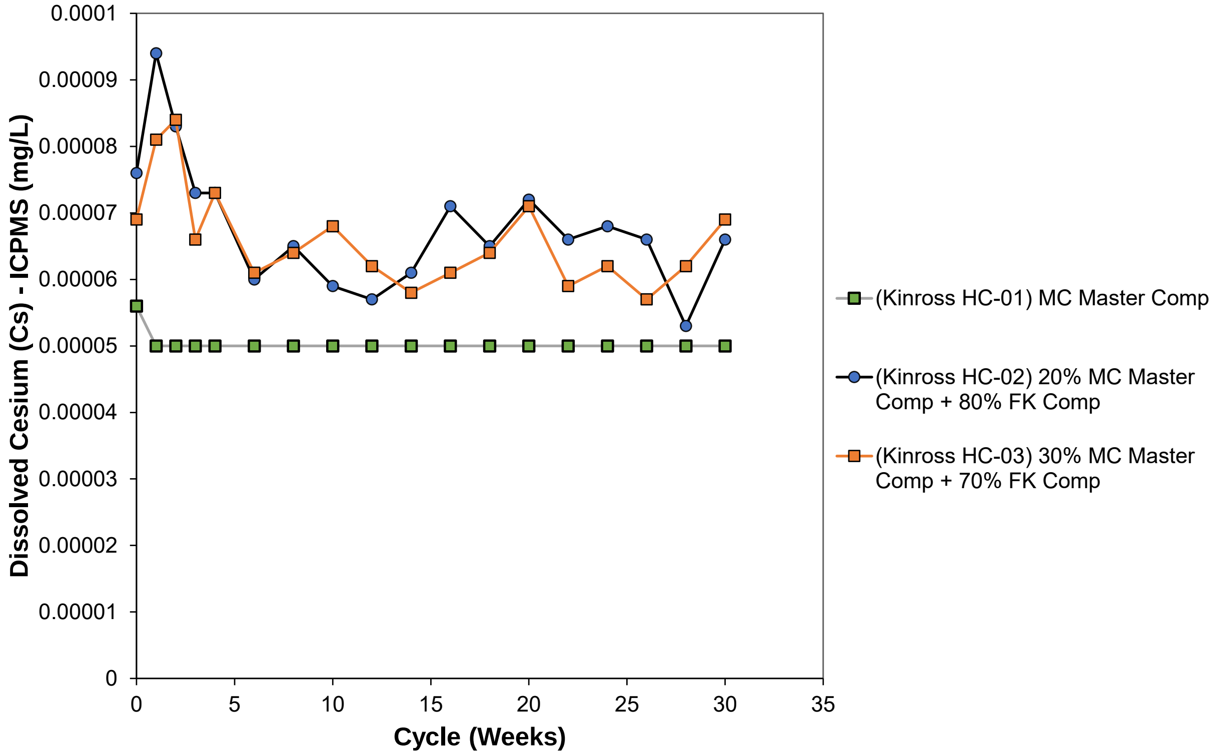

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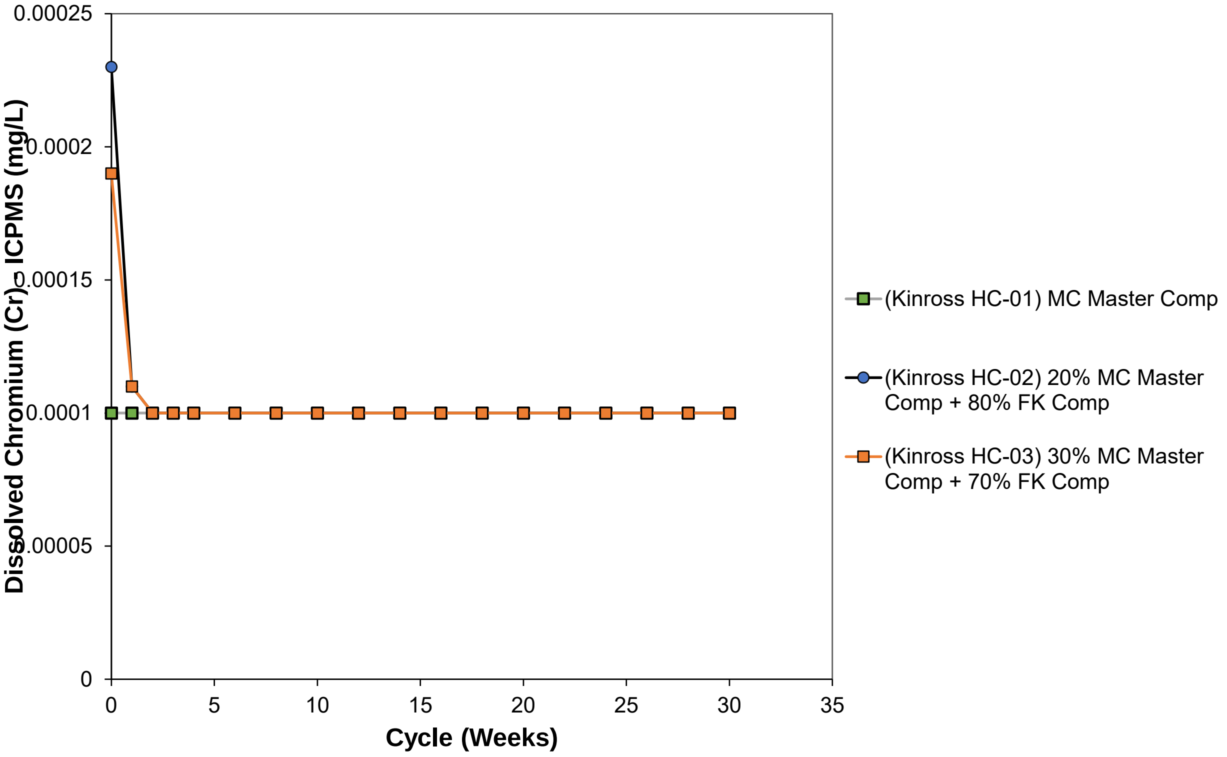

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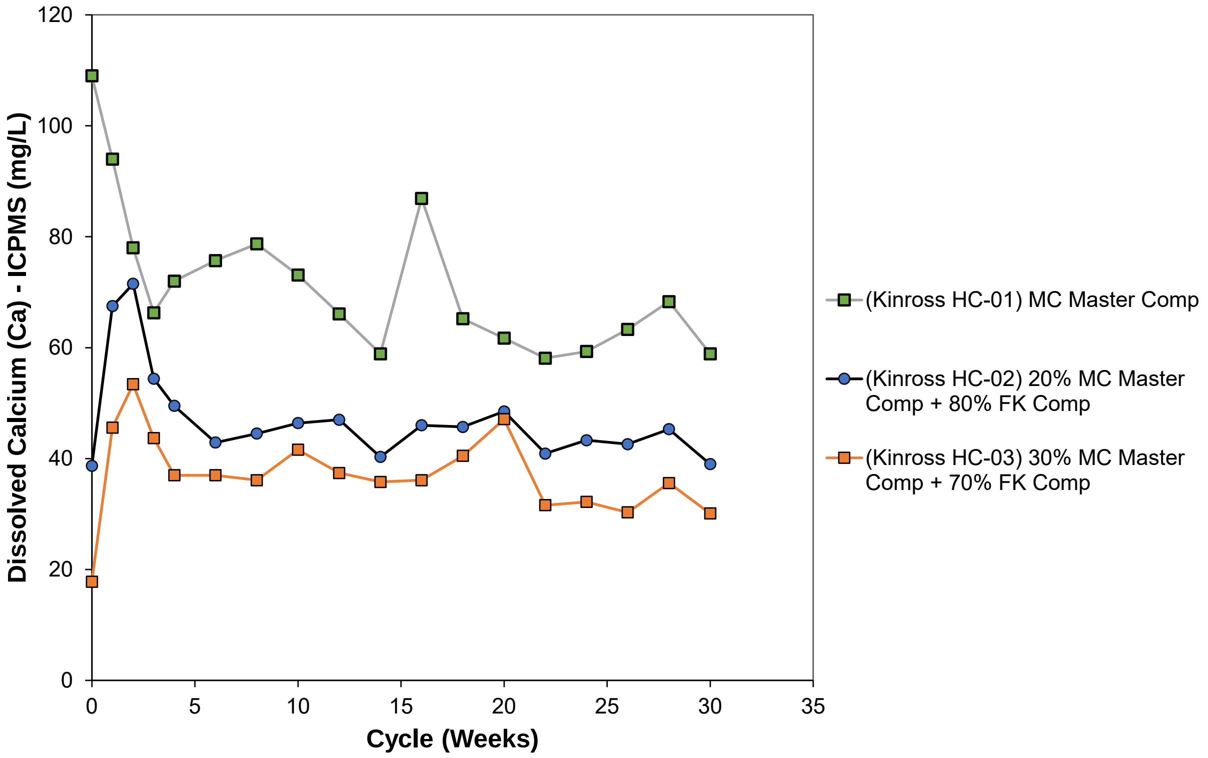

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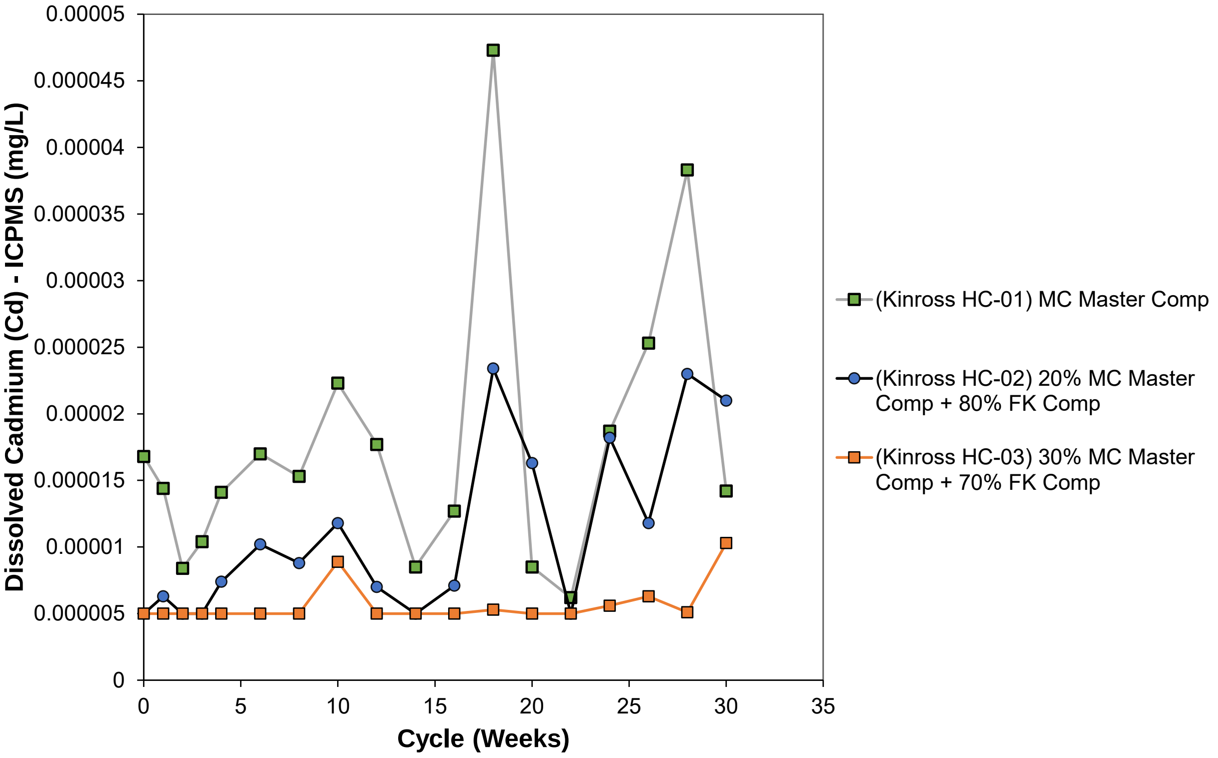

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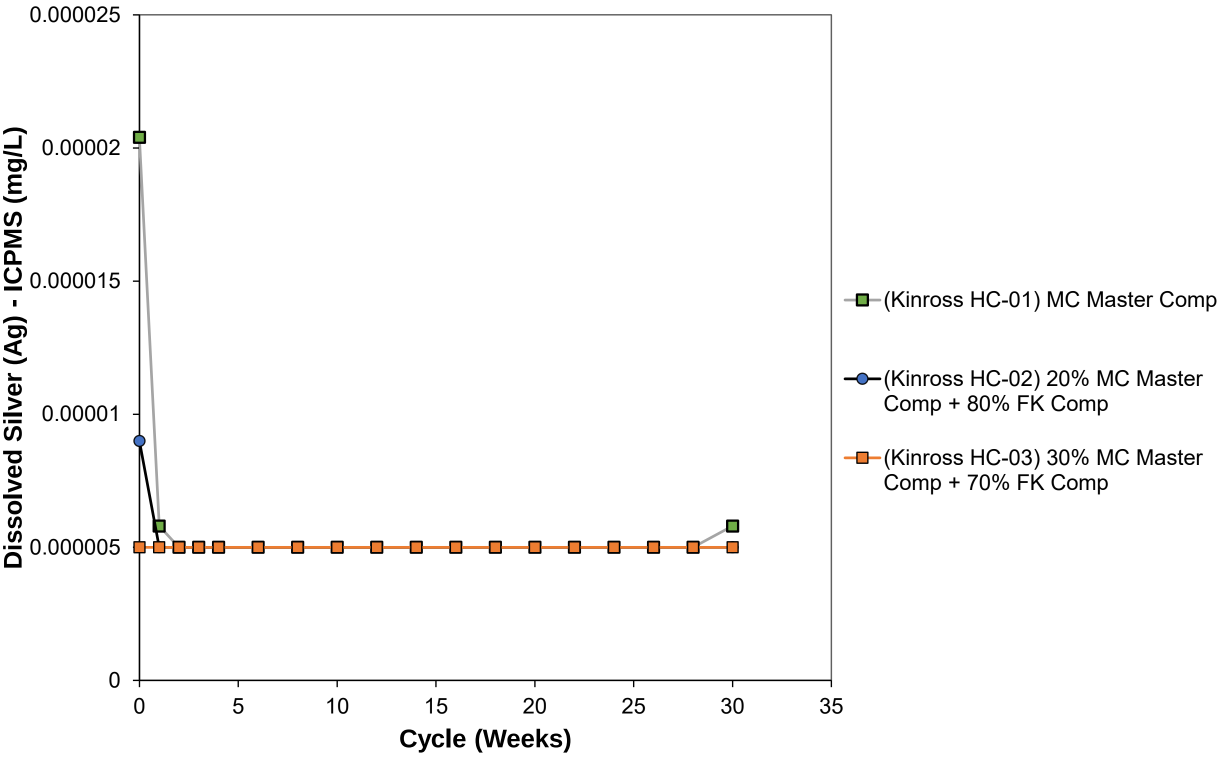

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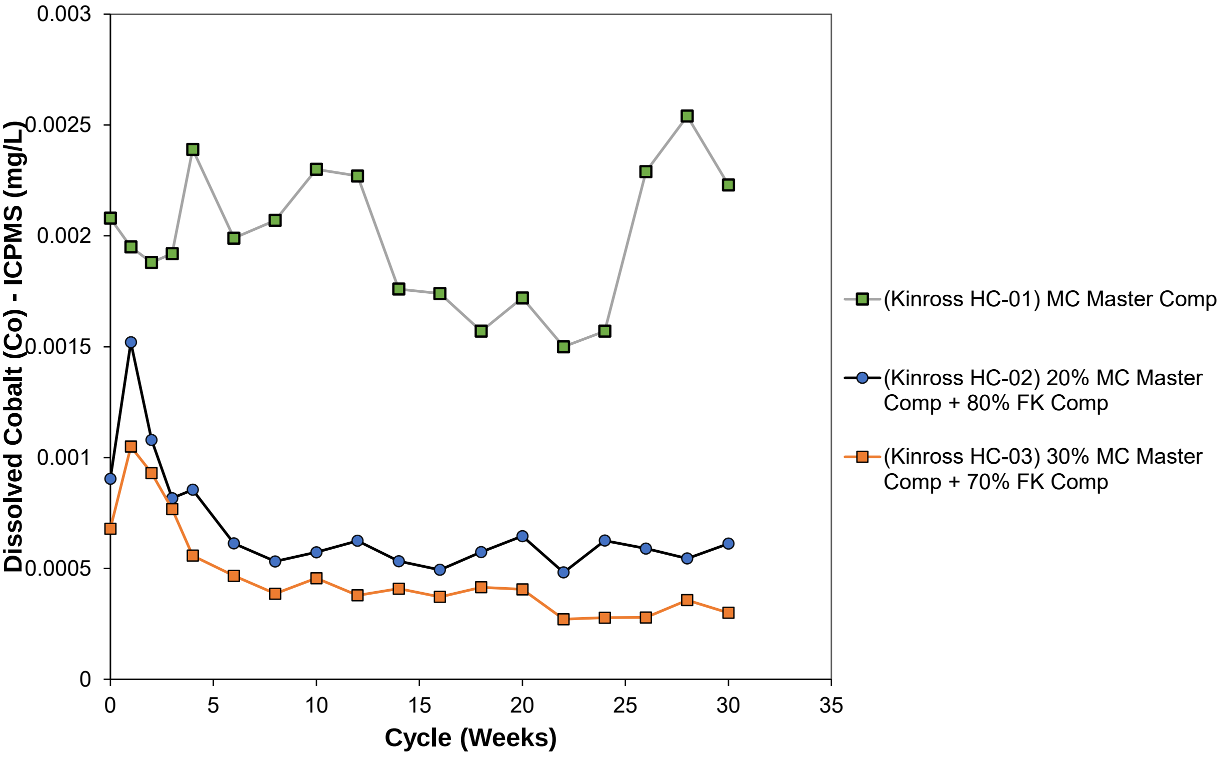

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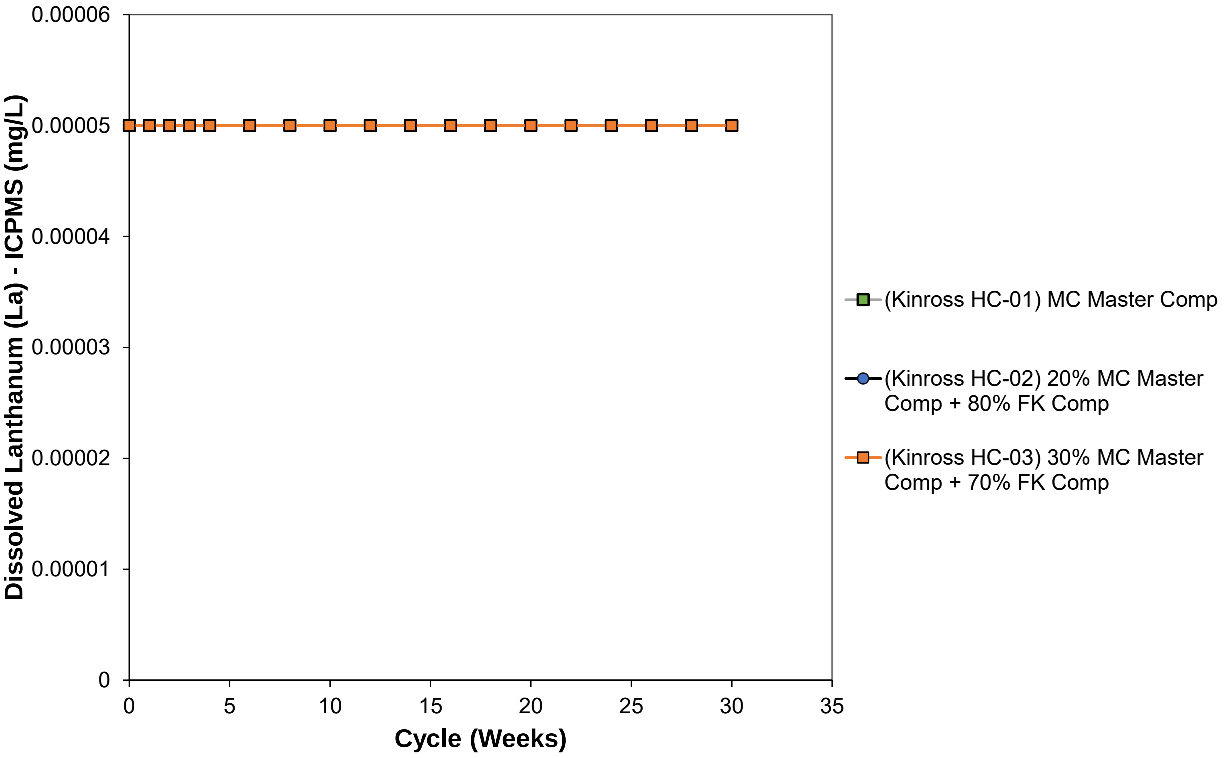

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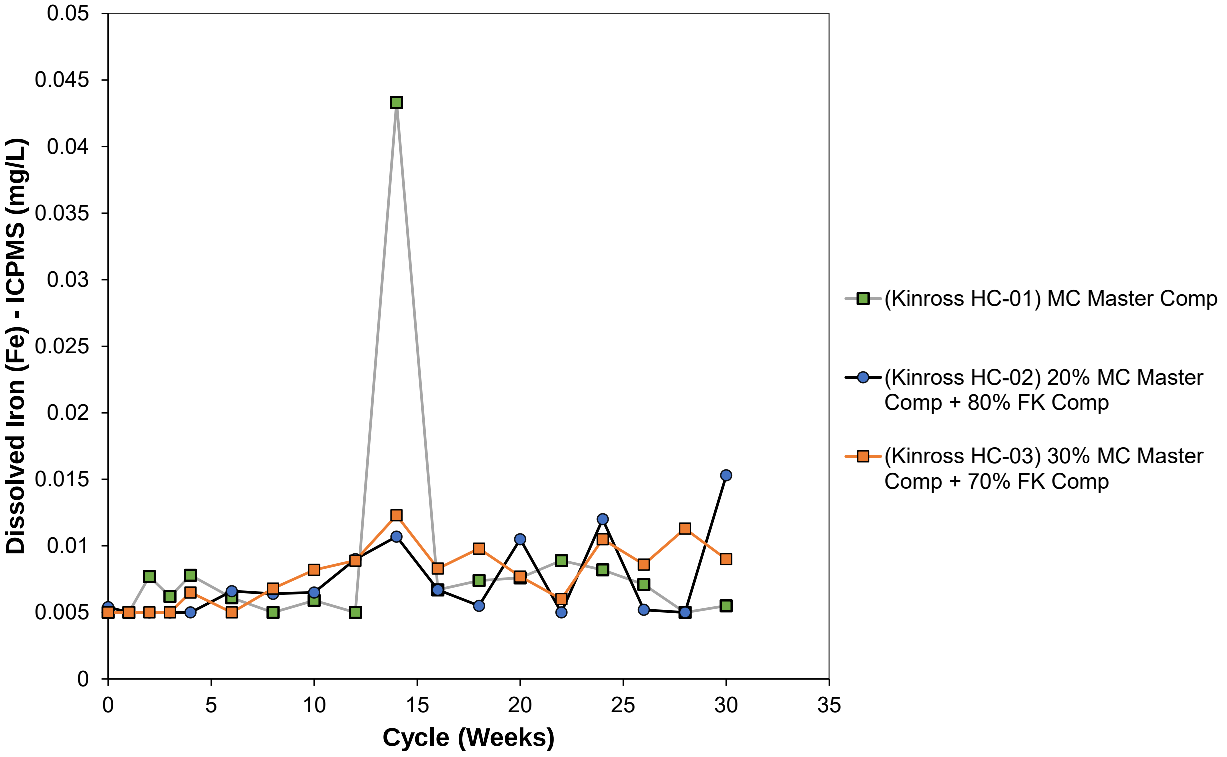

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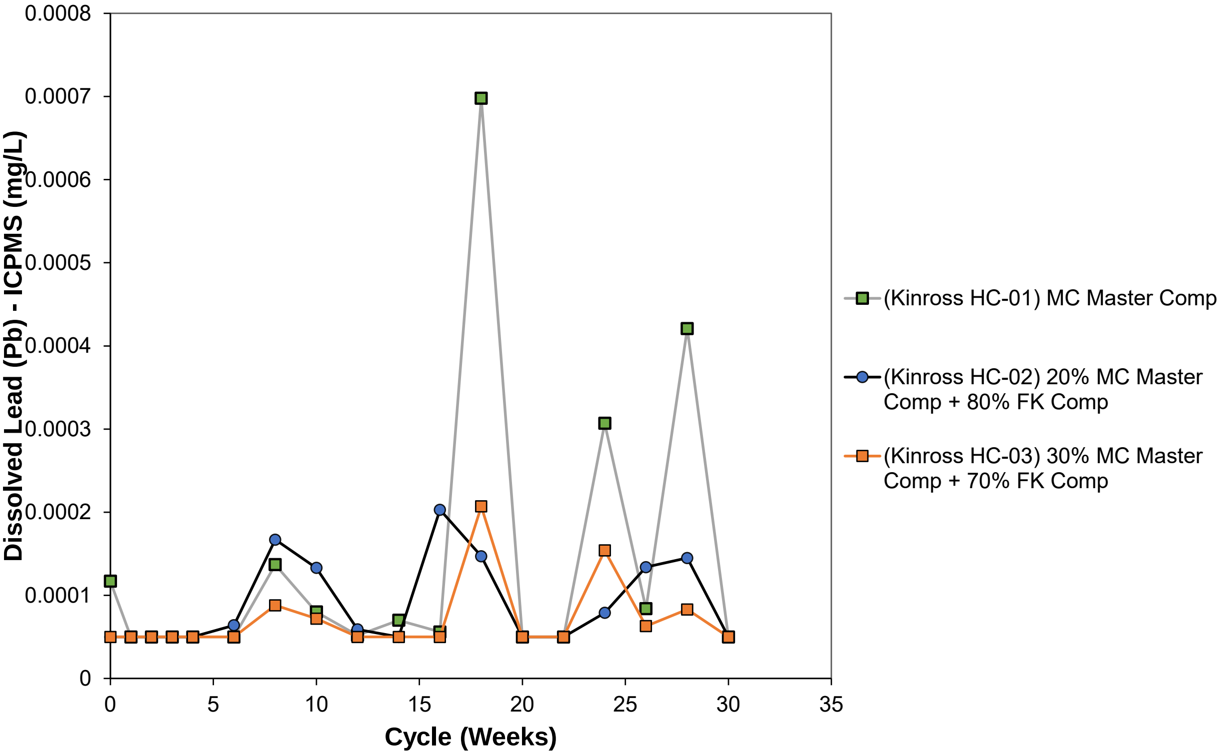

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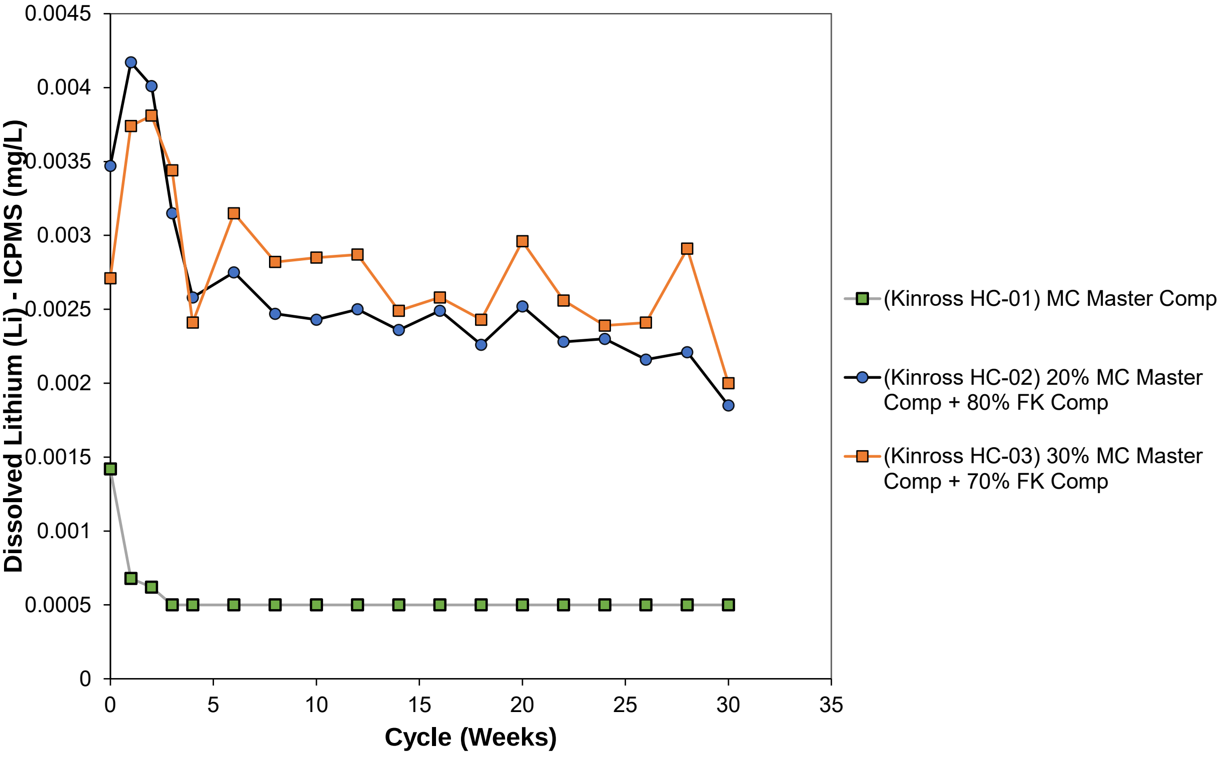

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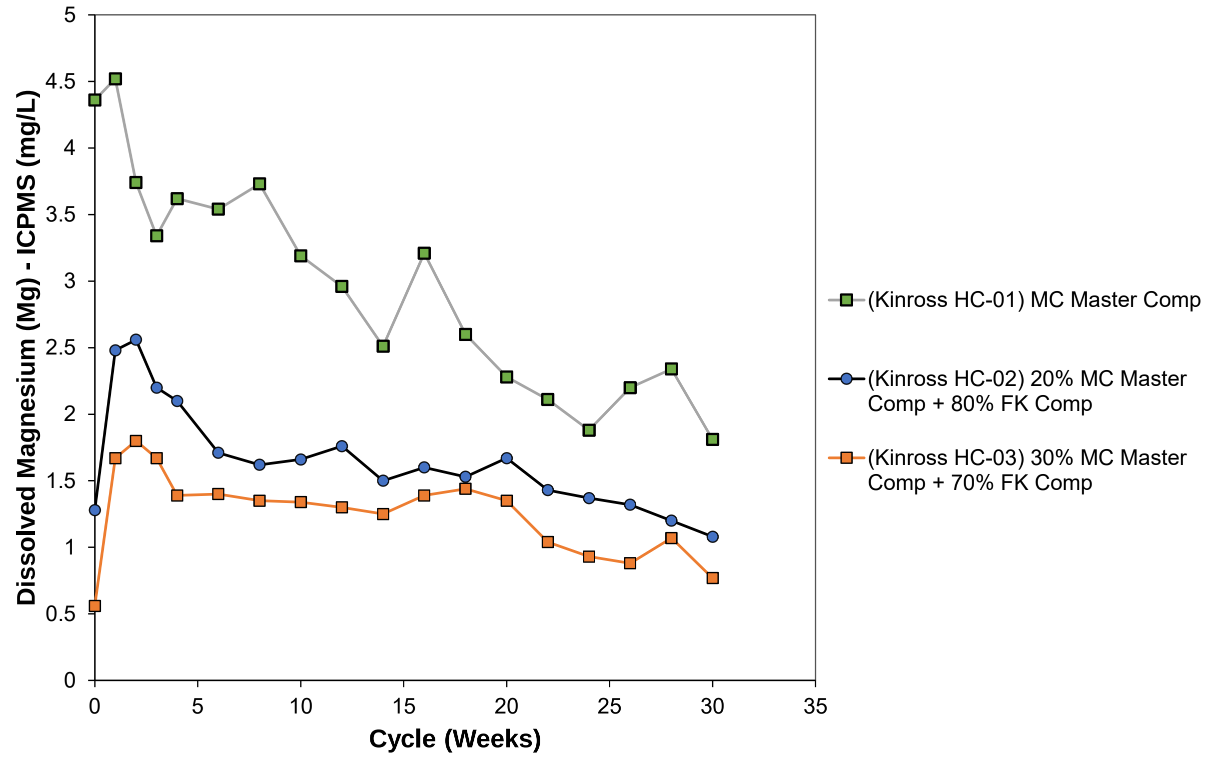

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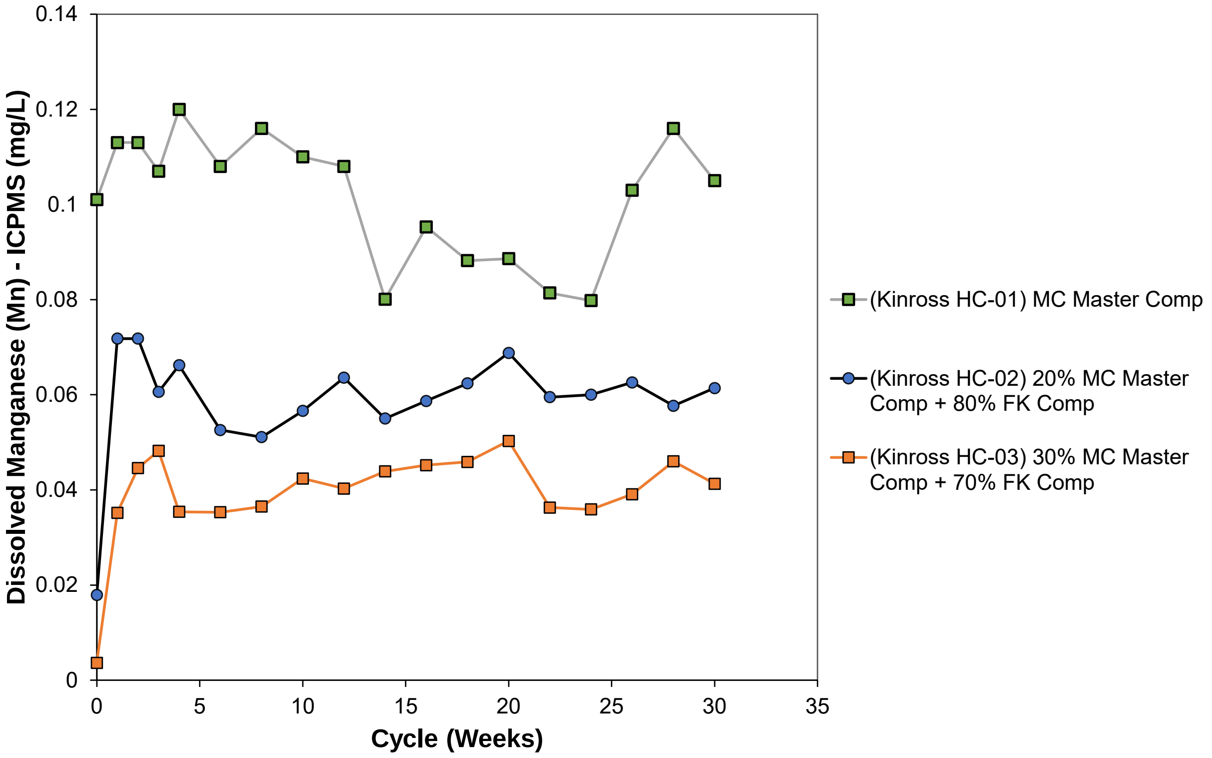

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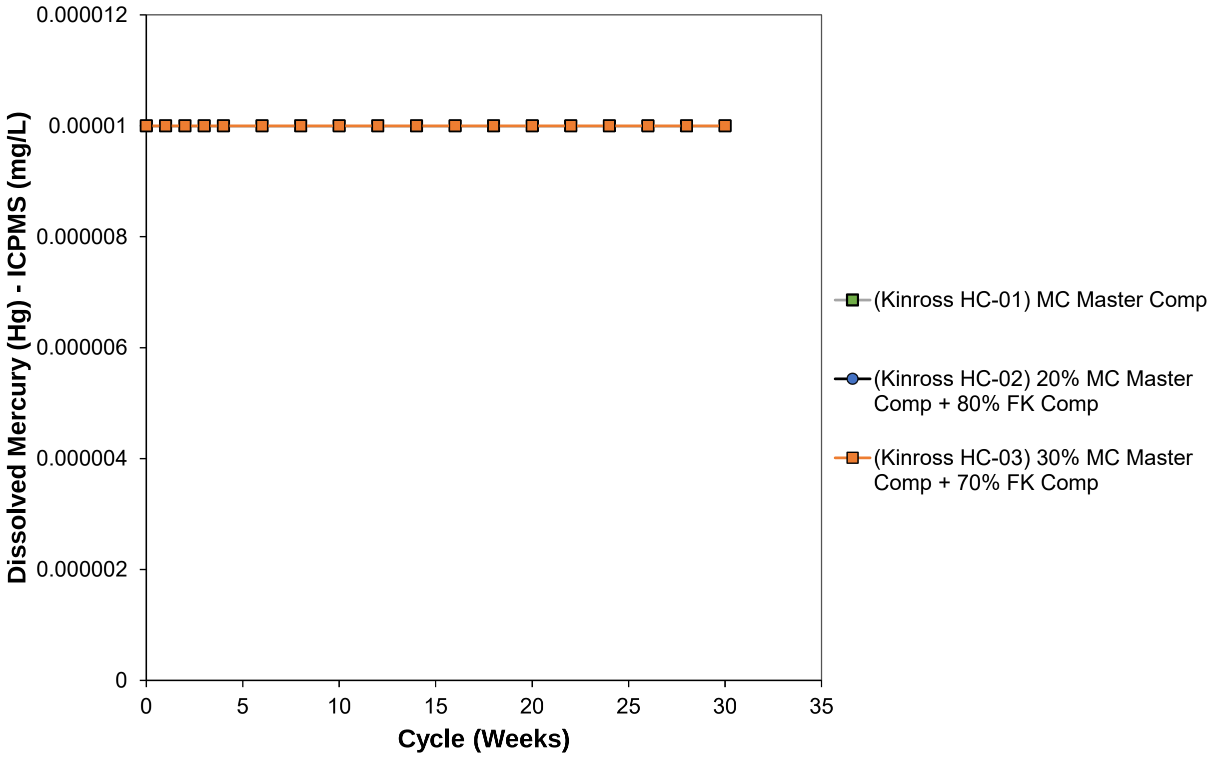

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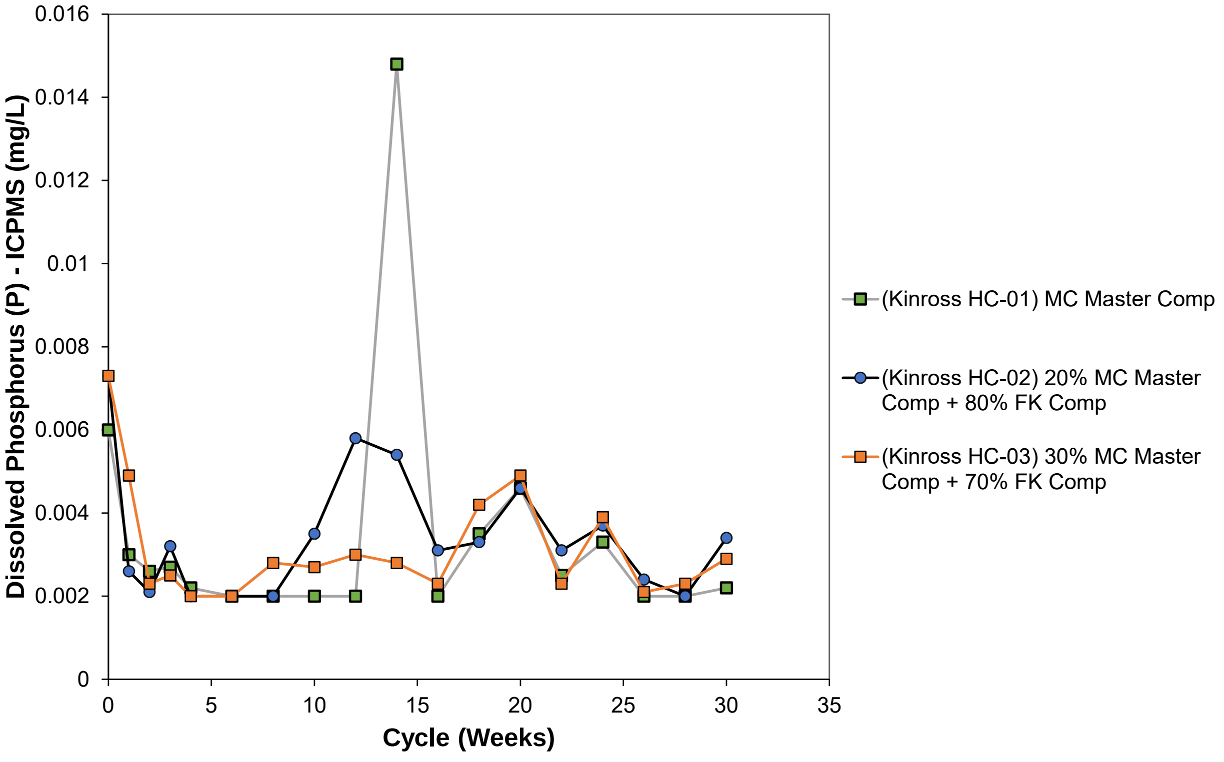

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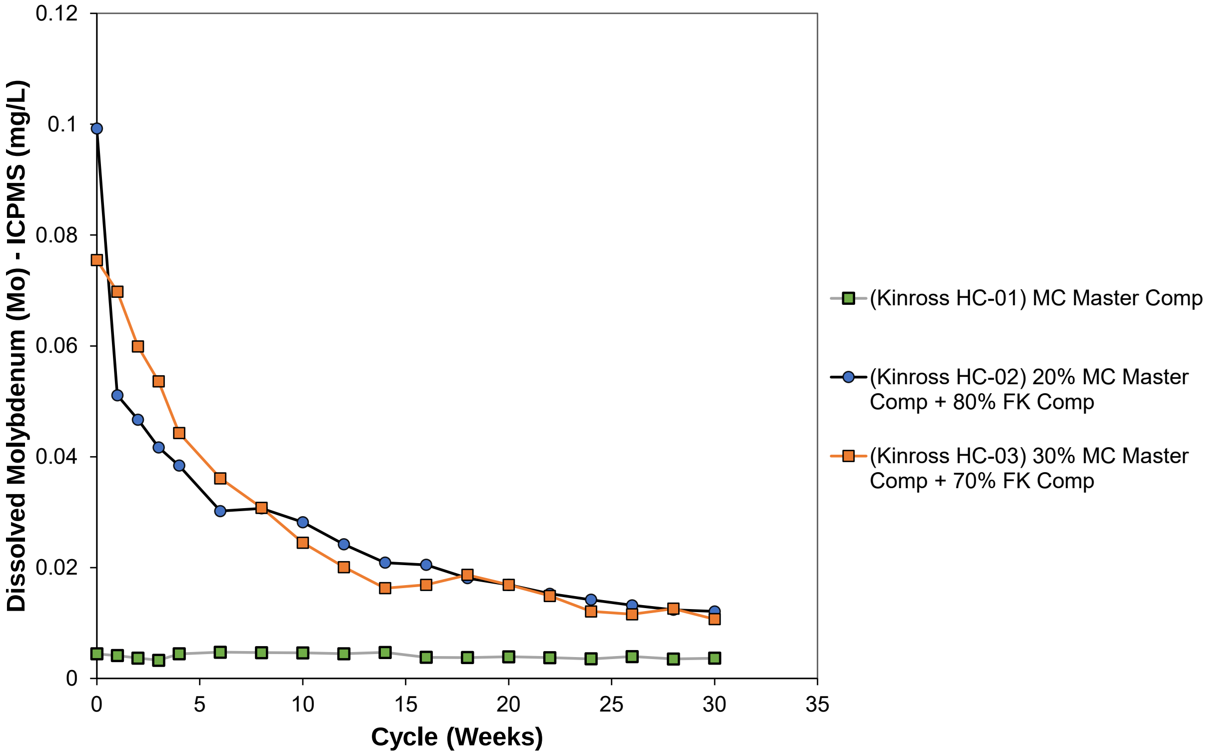

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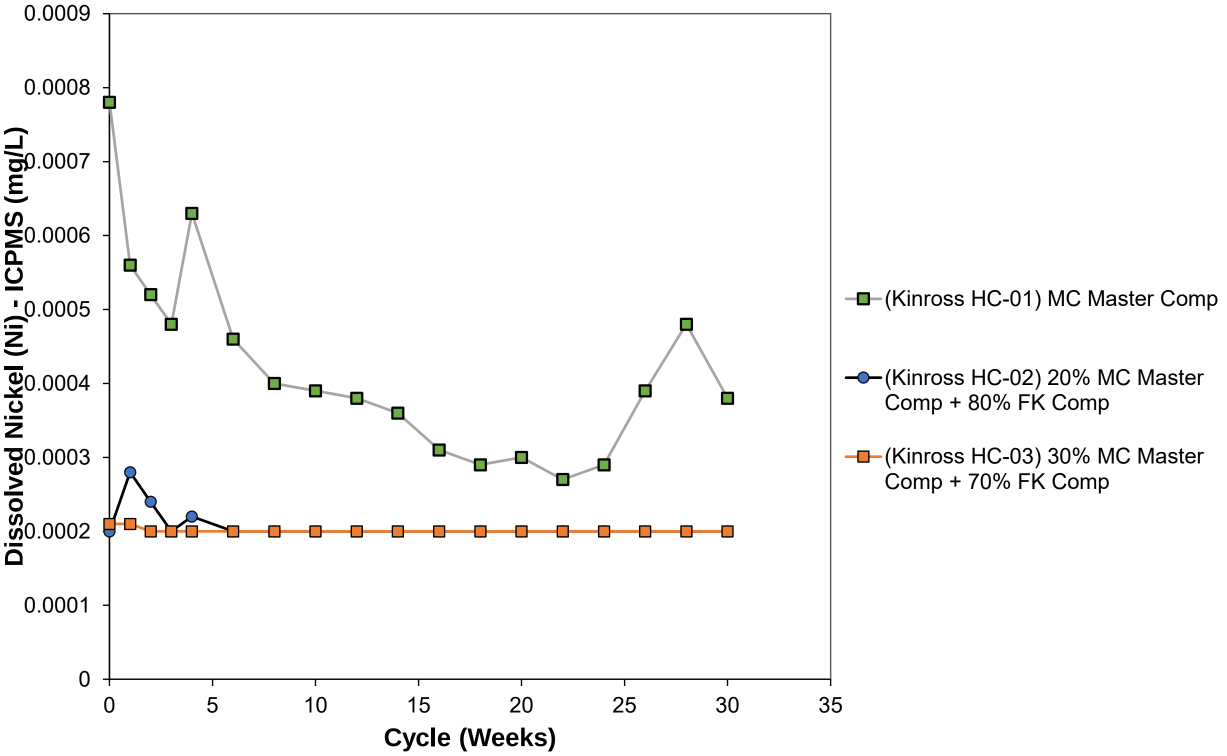

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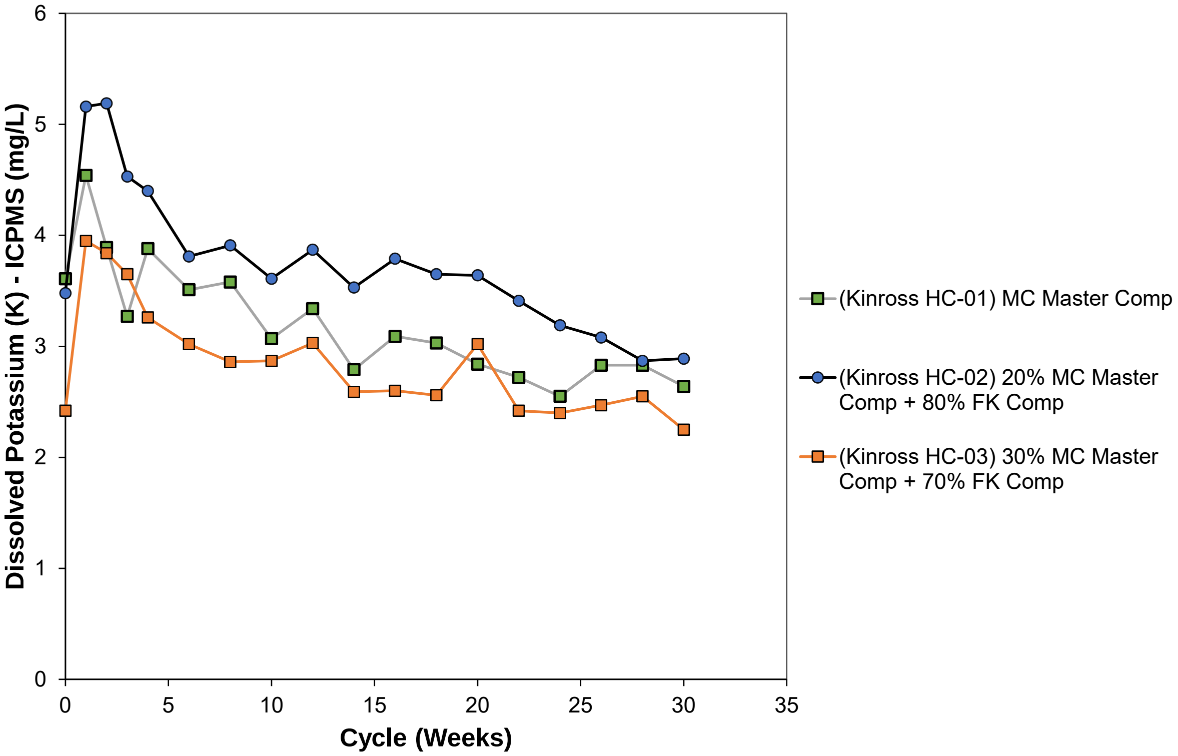

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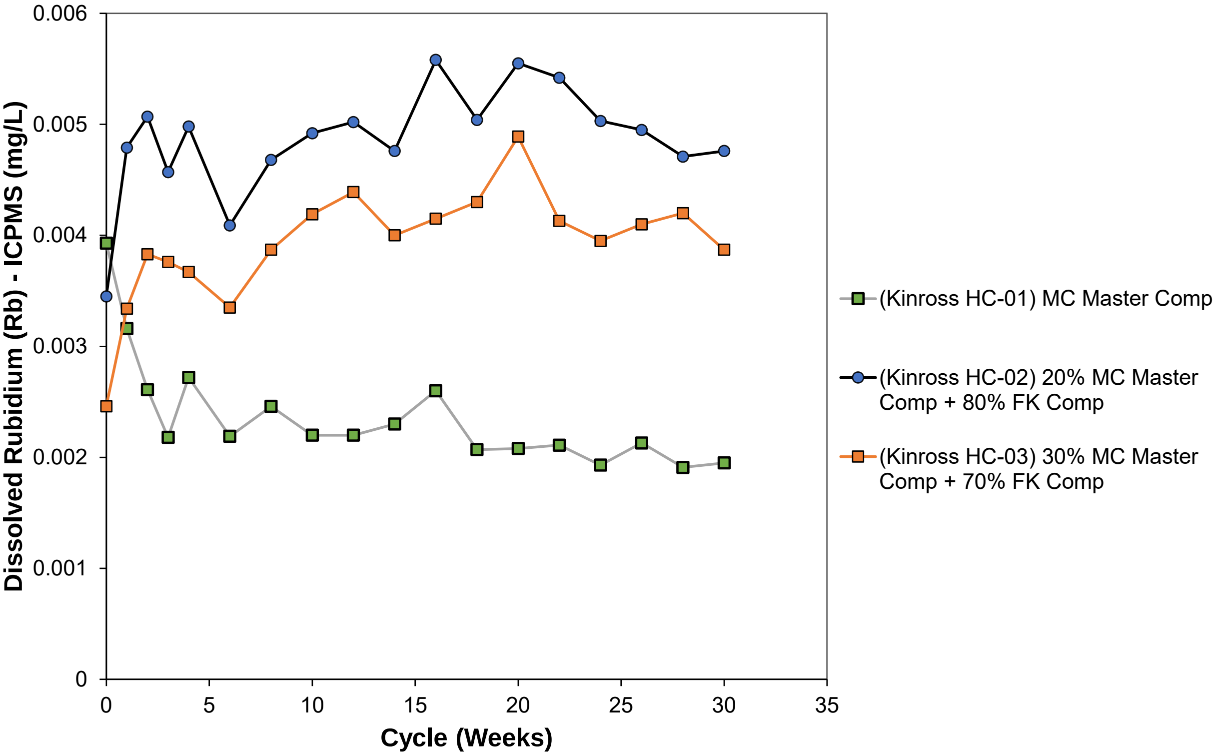

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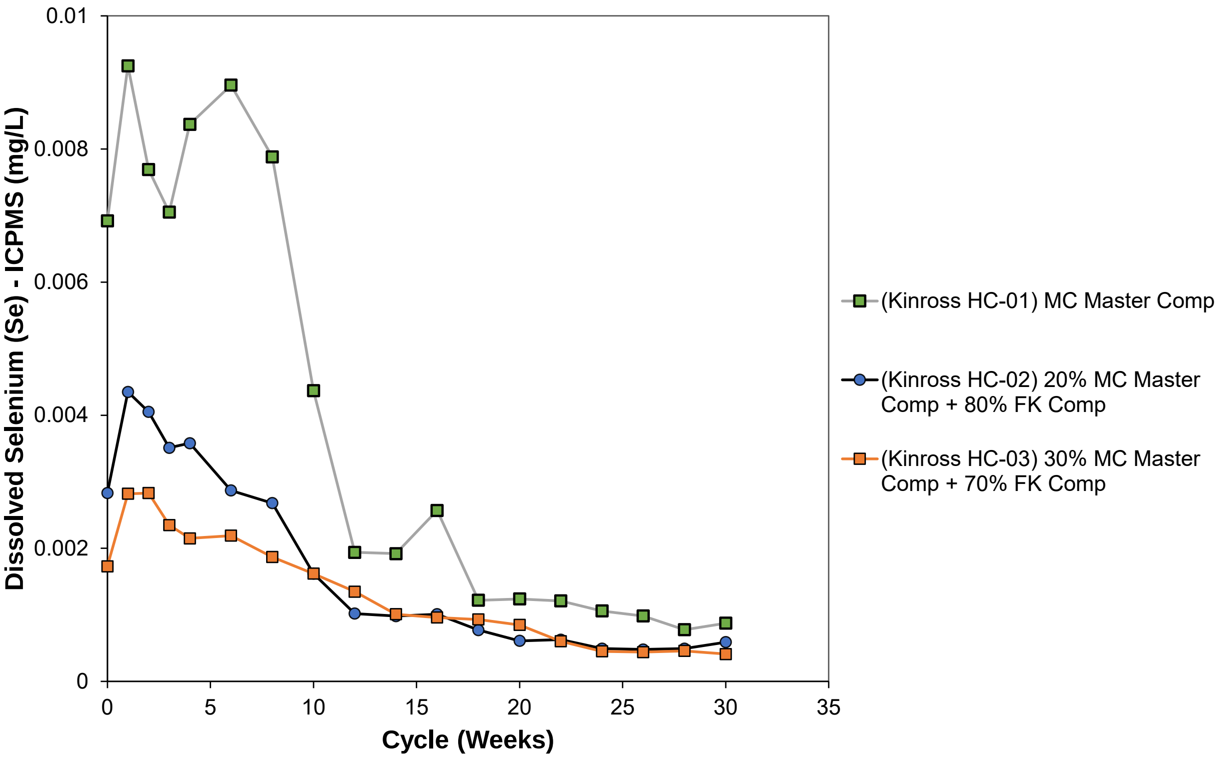

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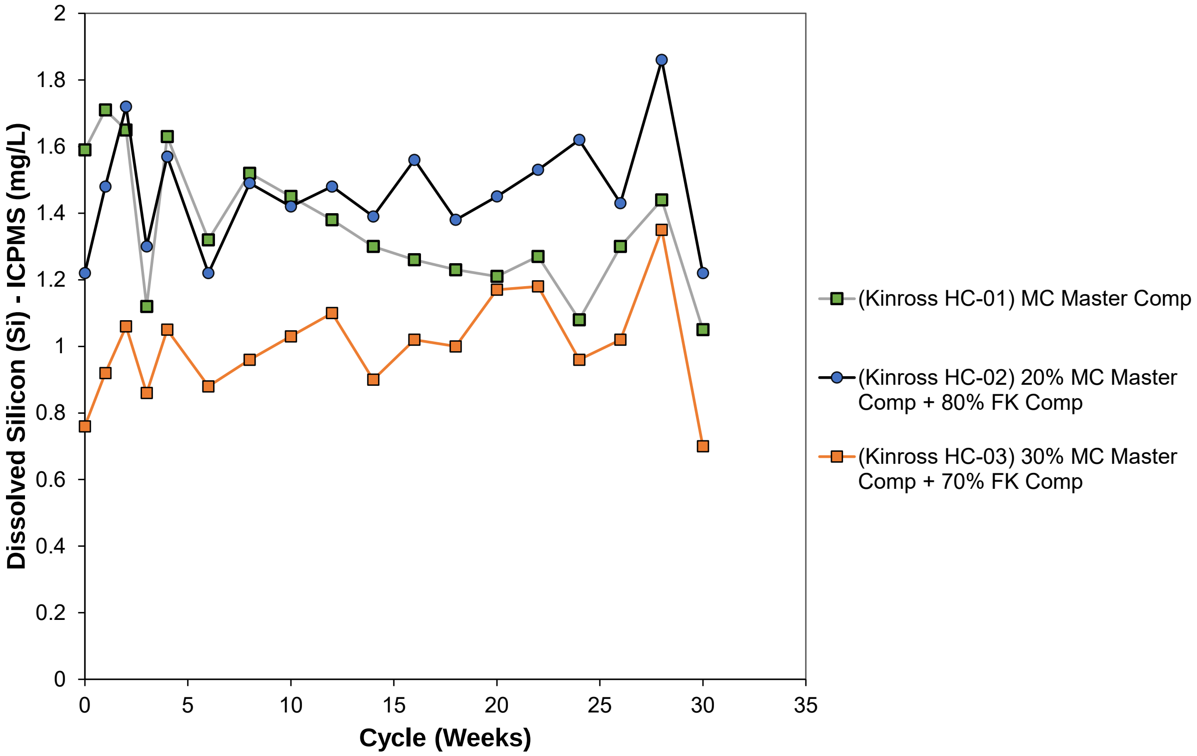

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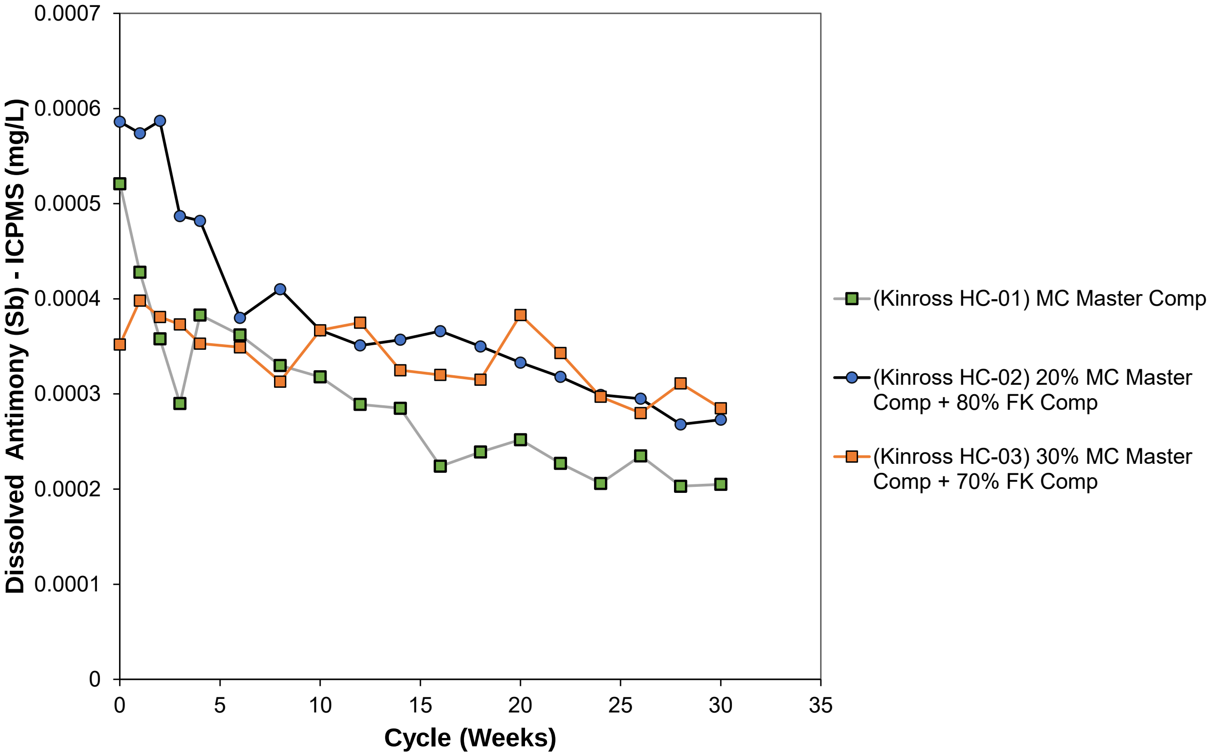

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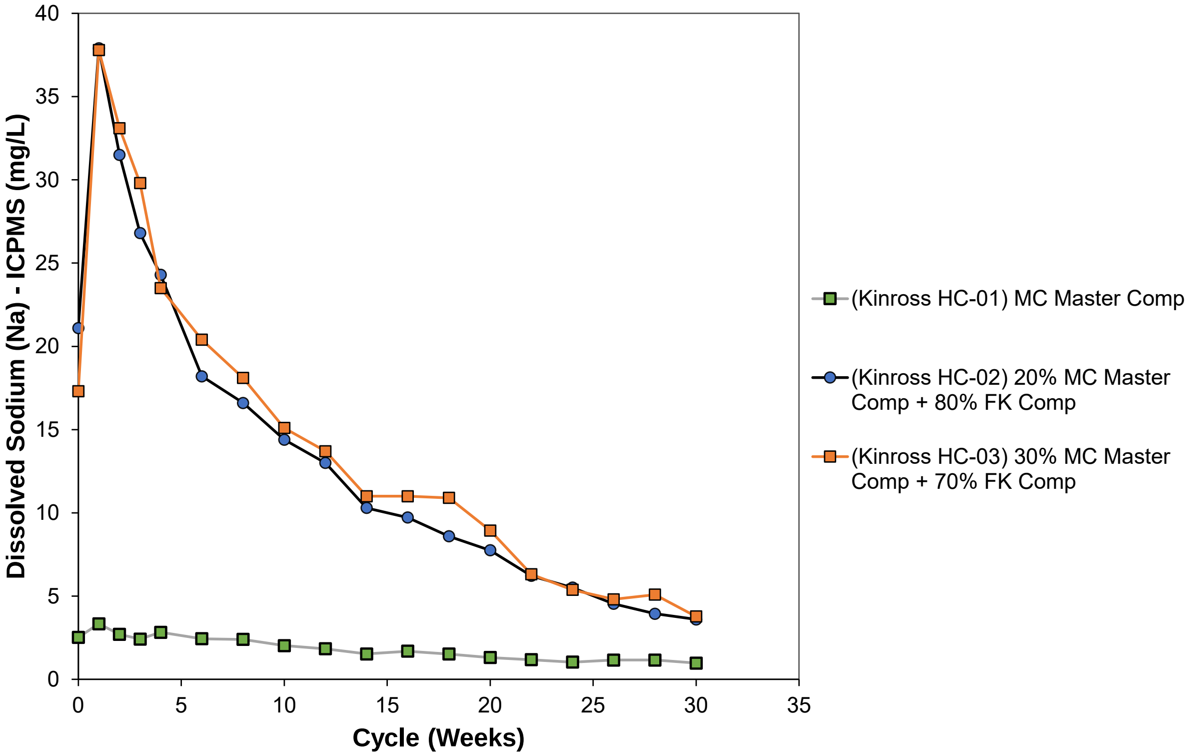

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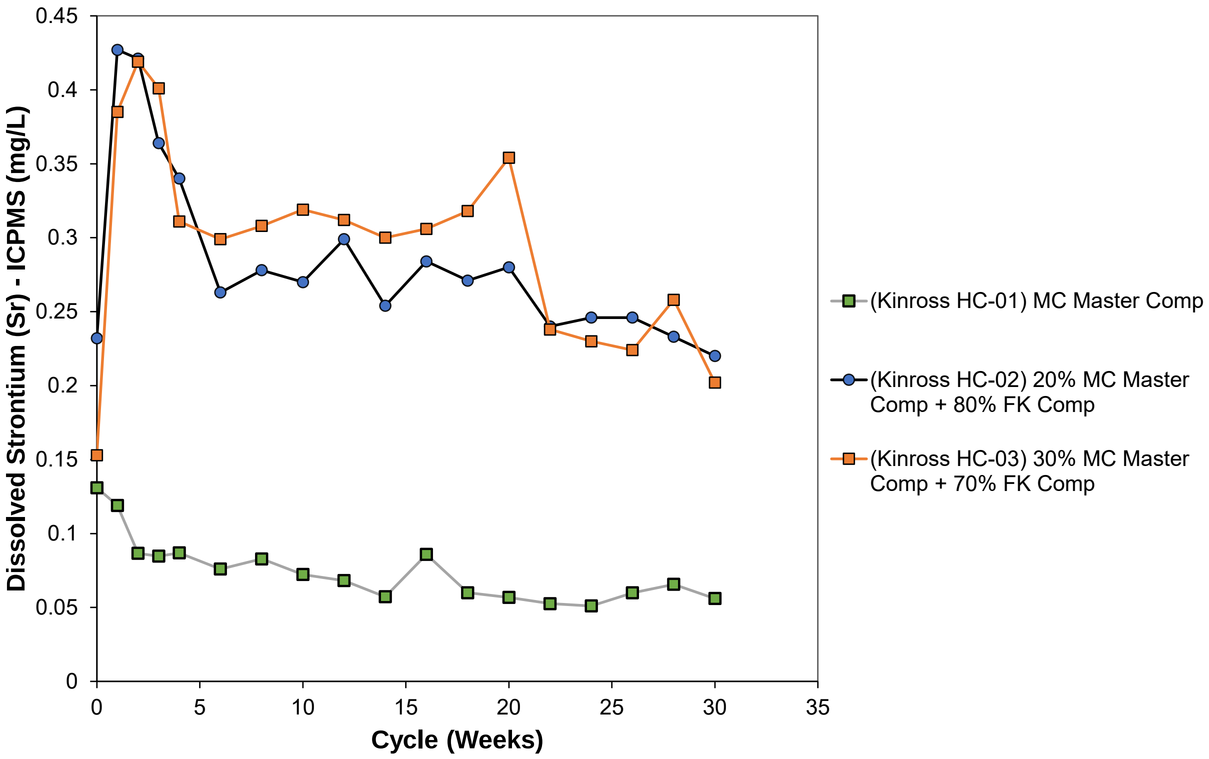

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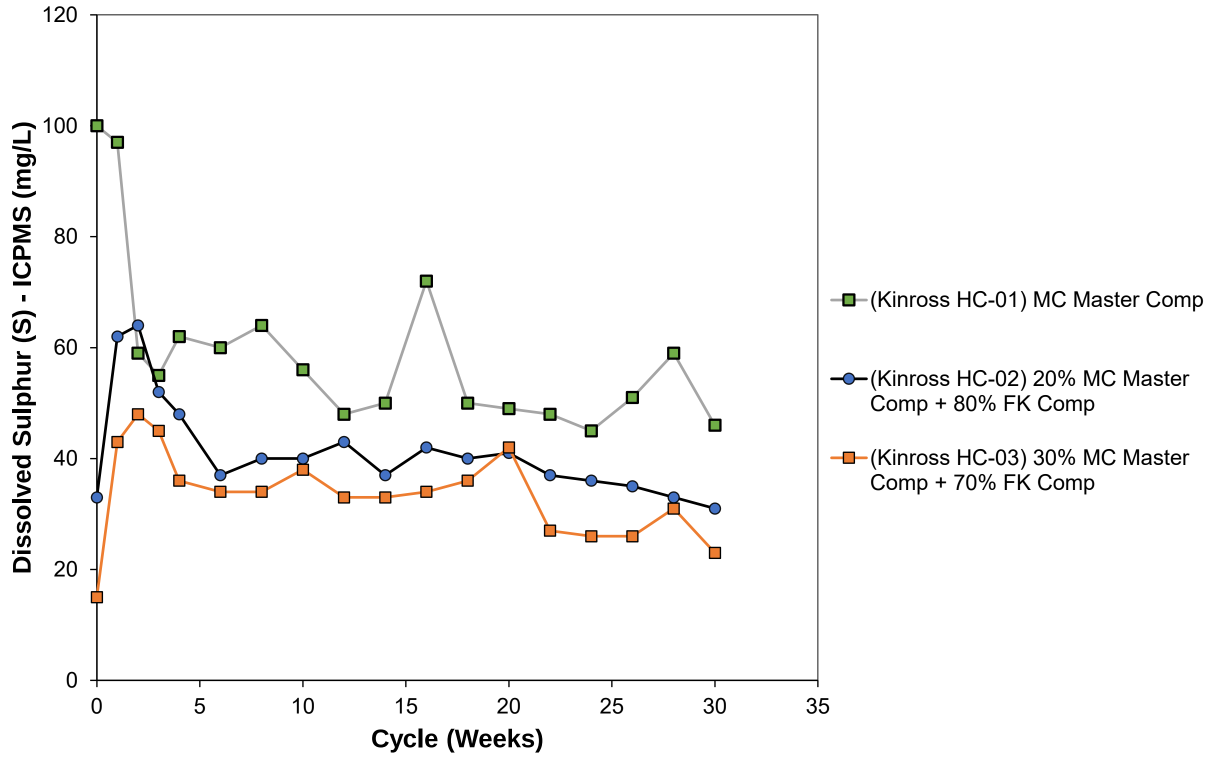

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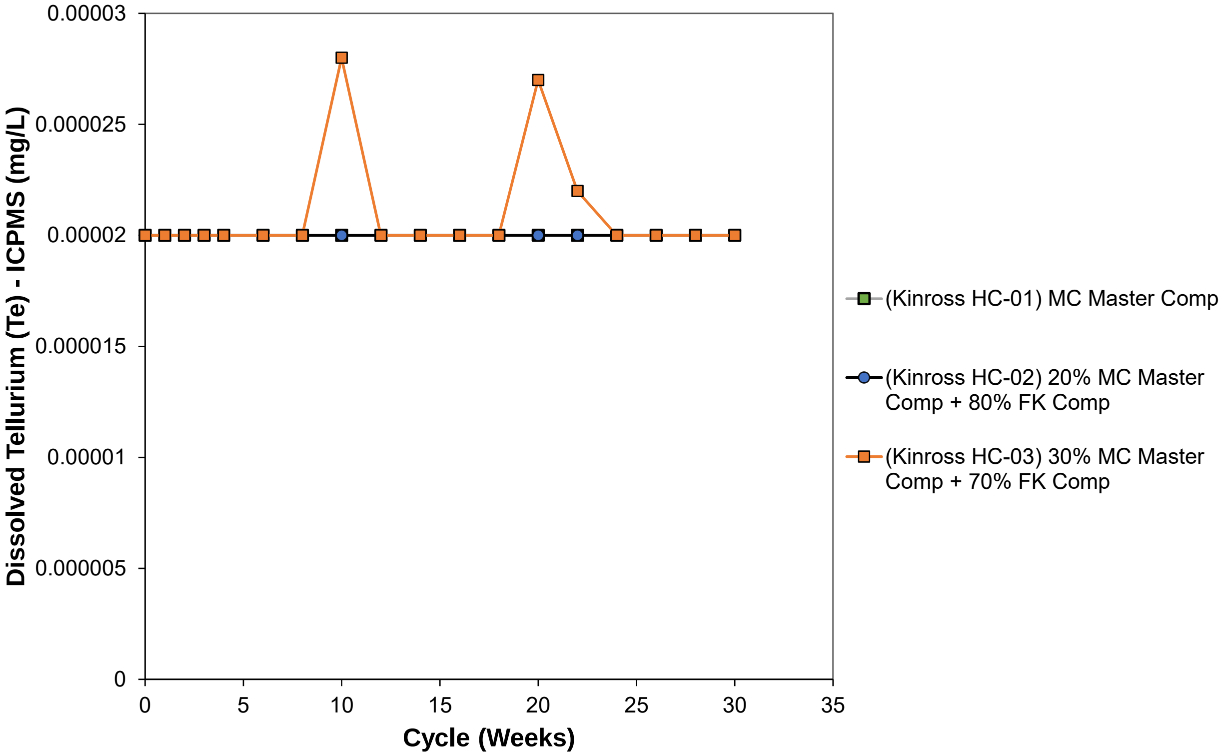

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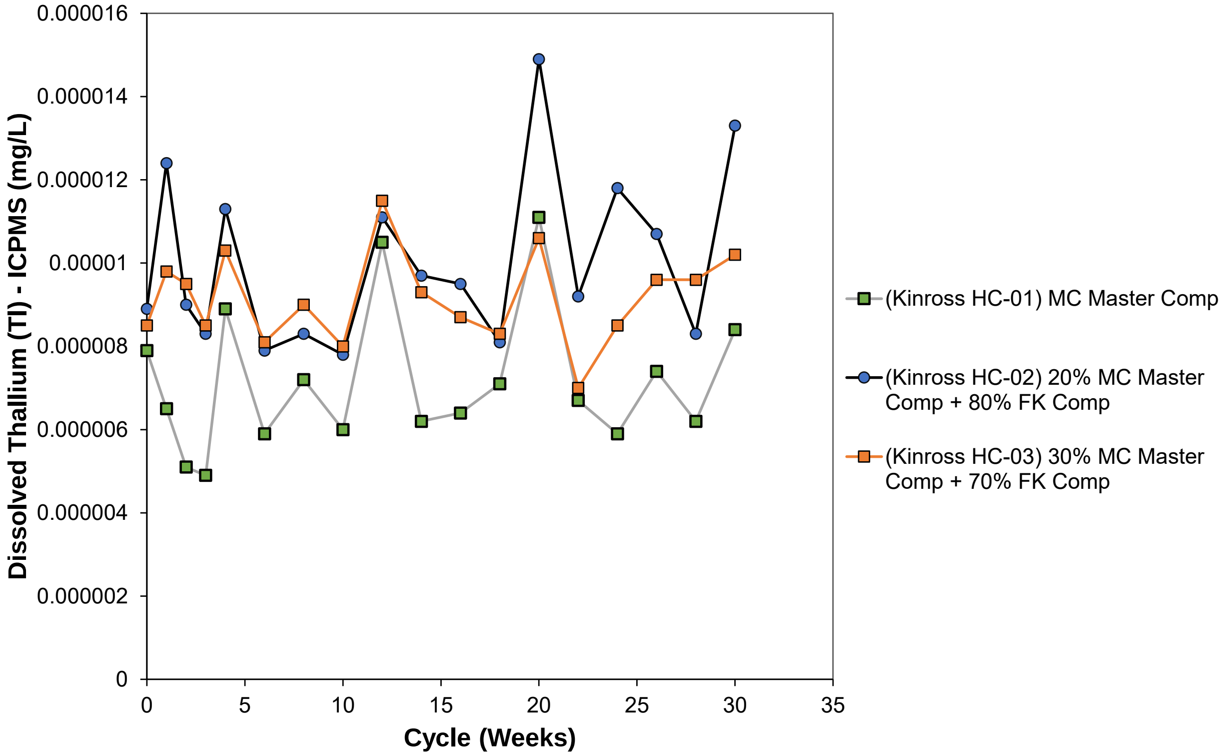

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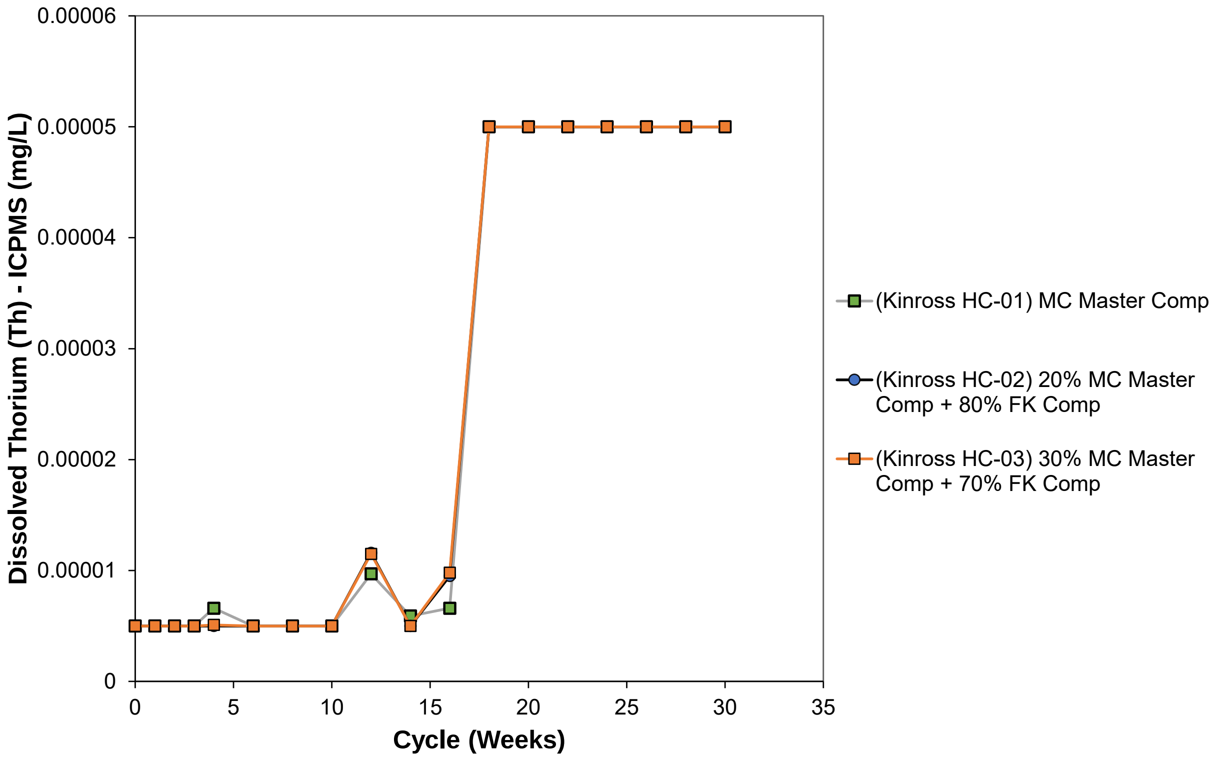

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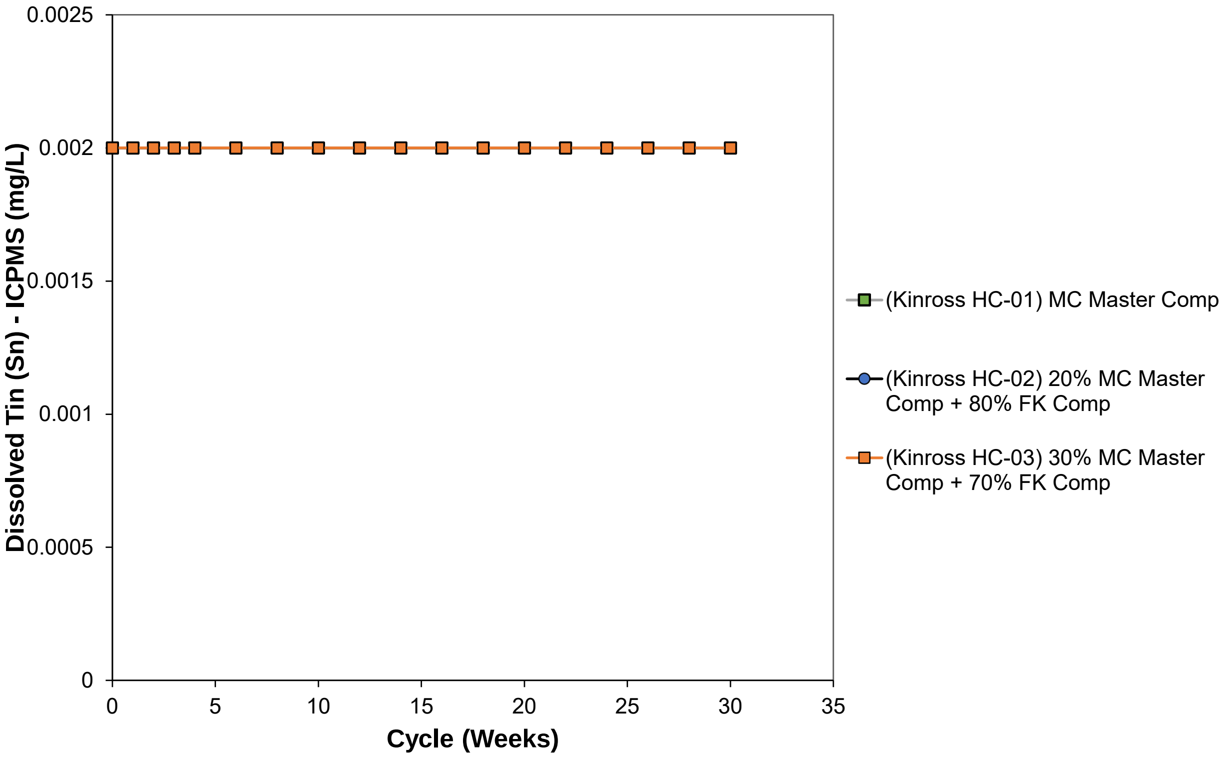

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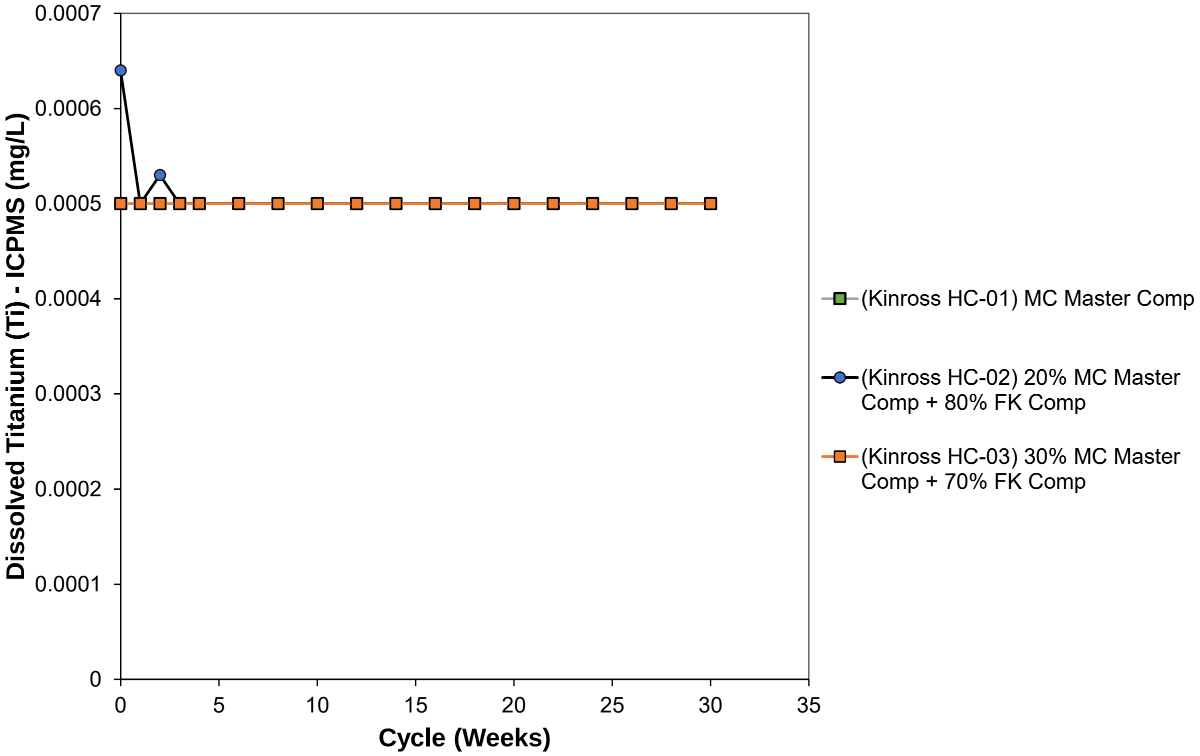

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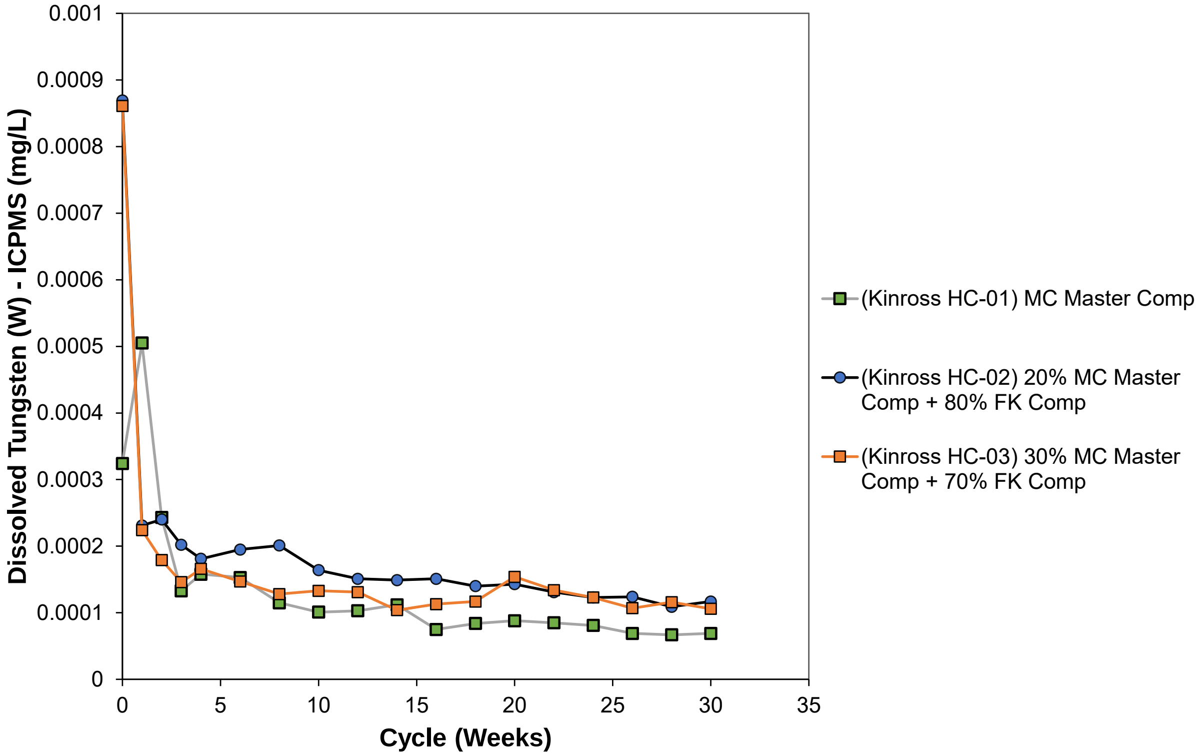

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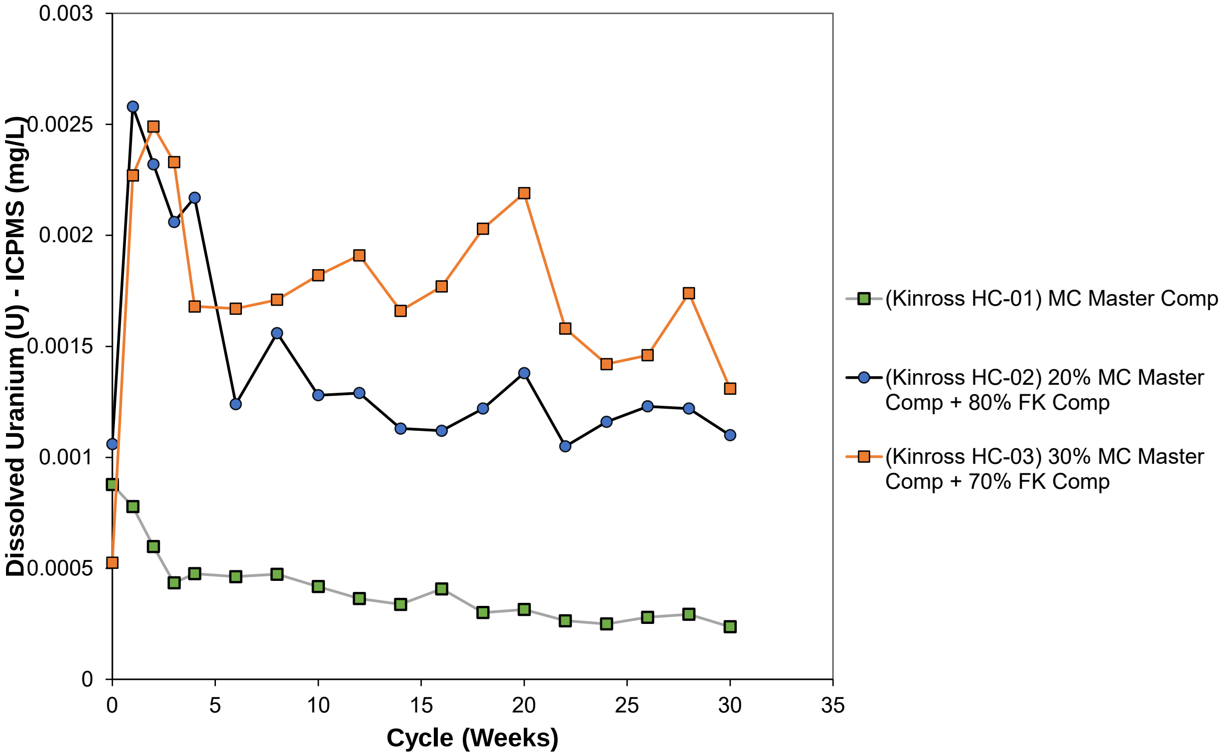

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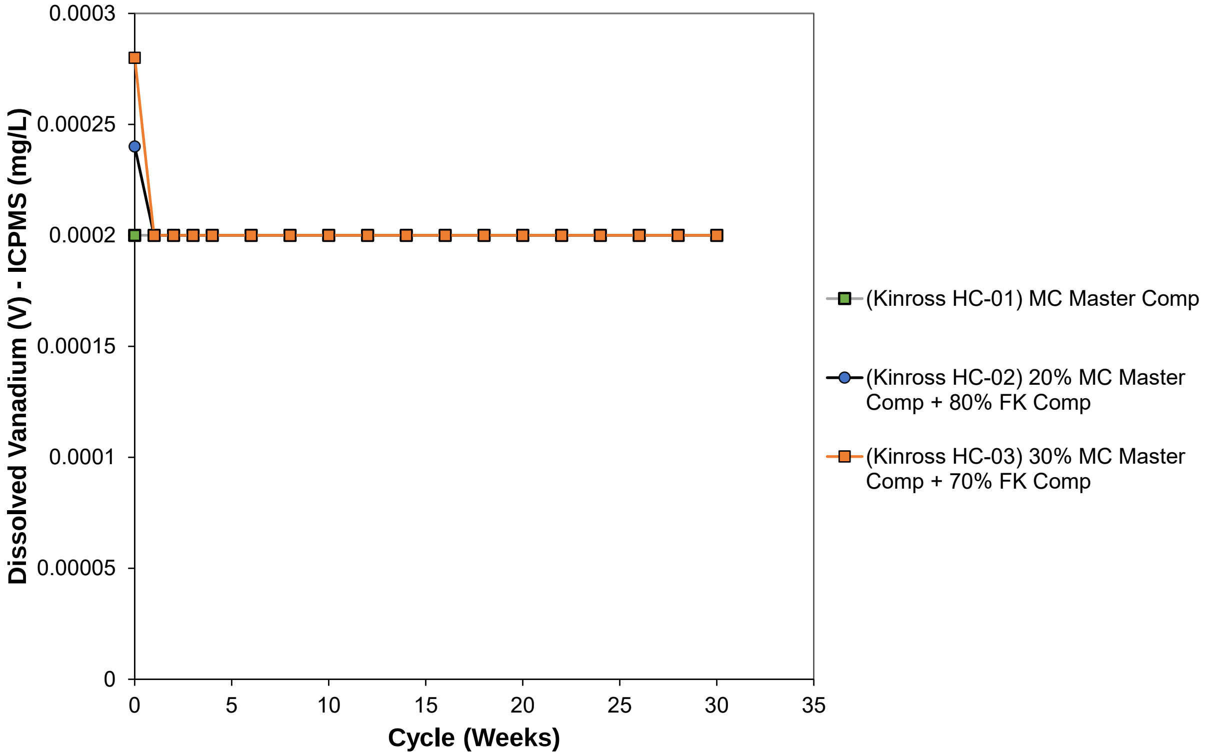

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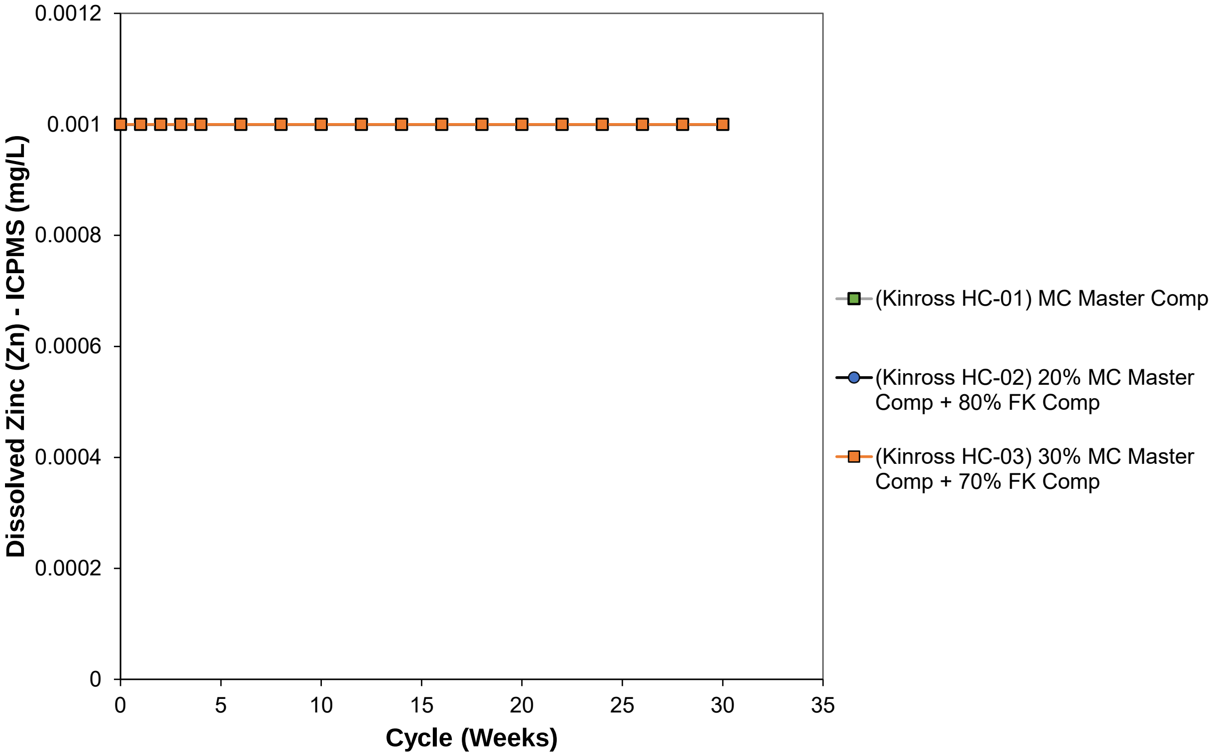

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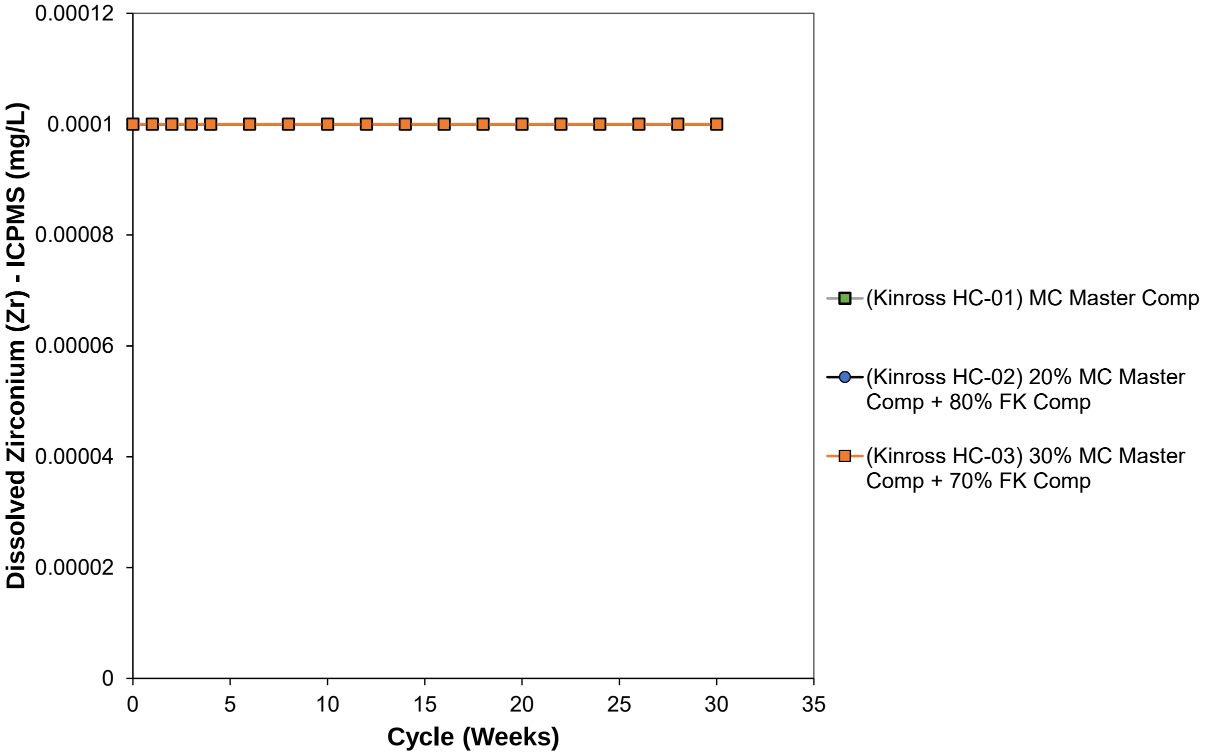

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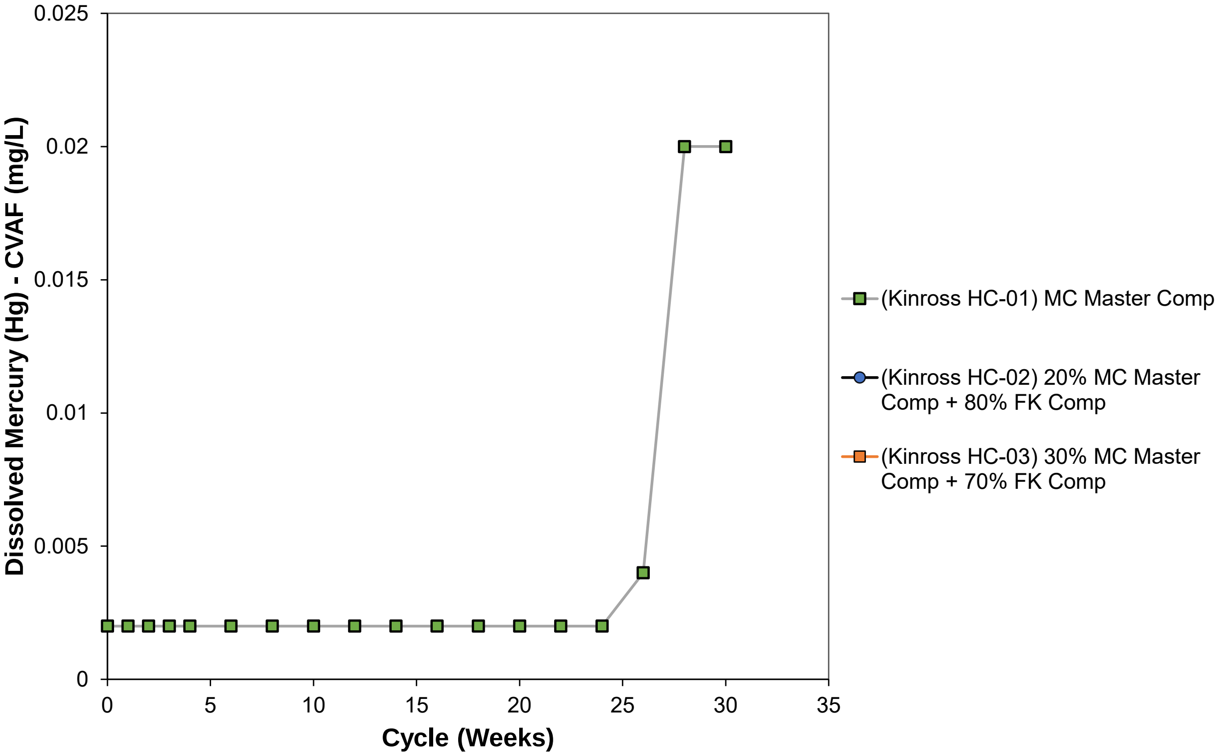

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