

# **APPENDIX 3.I**

## **Mine Rock Management Plan**

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# FORTUNE MINERALS LIMITED DEVELOPER'S ASSESSMENT REPORT

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## APPENDICES

### Appendix 3.1

Mine Rock Management Plan

### Attachment 3.1-I

Evaluation of Mine Rock Management Criteria

### 3.1.1 INTRODUCTION

The conceptual Mine Rock Management Plan (MRMP) of the Developer's Assessment Report (DAR) for the Fortune Minerals Limited (Fortune) NICO Cobalt-Gold-Bismuth-Copper Project (NICO Project) describes how Mine Rock, sediment, and overburden will be managed as it is disturbed and/or mined.

The use of Mine Rock, sediment, and overburden for construction at the NICO Project must comply with the site-specific Mine Rock management criteria. The objective of the MRMP is to provide information that can be used to assess and manage the potential for acid rock drainage/metal leaching during the construction and operations phases of the proposed NICO Project.

This MRMP is organized into several sections, including the following:

- overview of site geology and mineralization;
- discussion of the quantity and distribution of Mine Rock during operations and construction;
- overview of the geochemical characteristics of Mine Rock;
- definition of Mine Rock classification criteria and preliminary Mine Rock sampling and testing plan;
- discussion of borrow material requirements and preliminary borrow material sampling and testing plan; and
- overview of performance monitoring protocols.

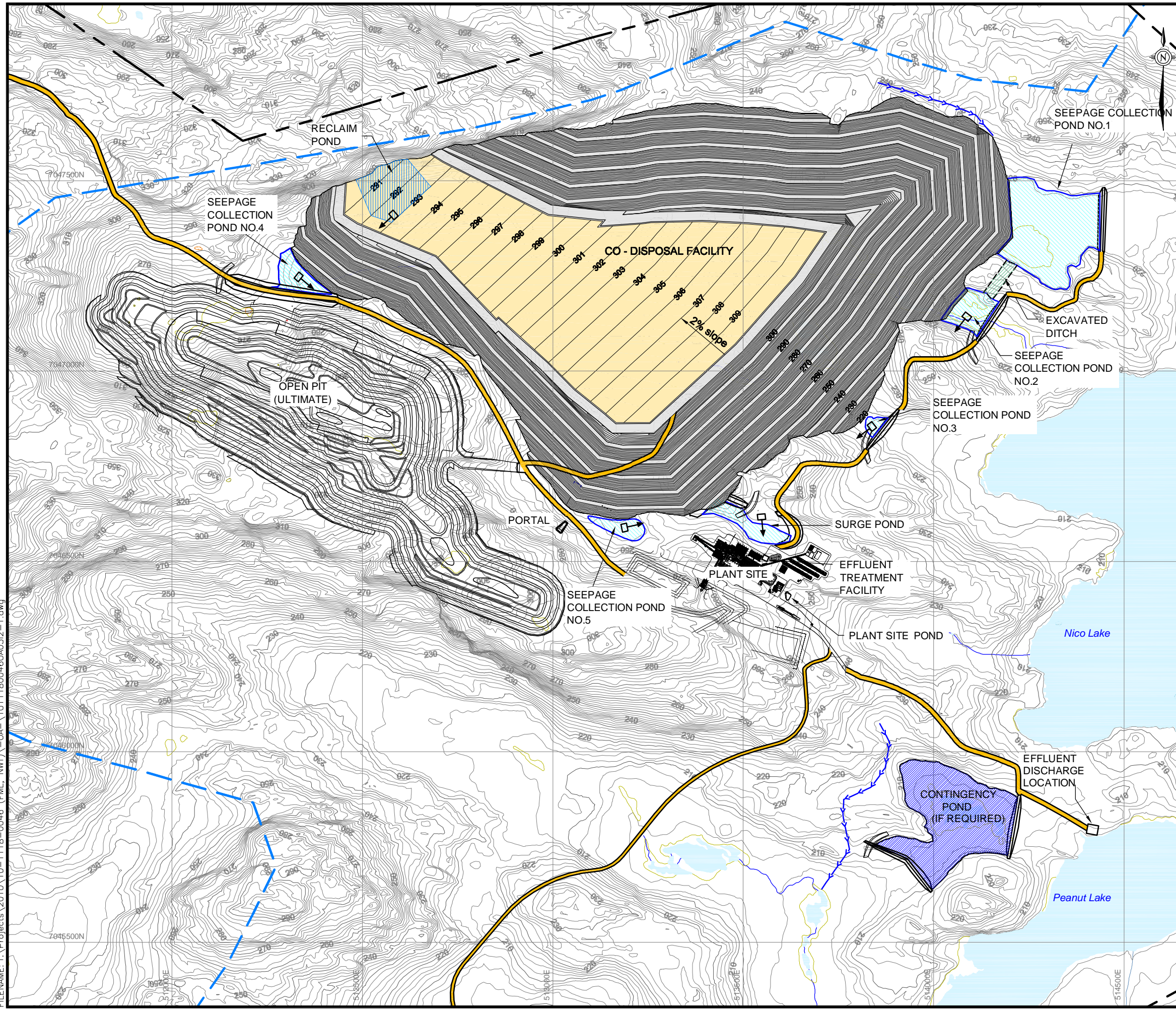
The conceptual MRMP is based on preliminary engineering studies for the NICO Project. Fortune will continue to refine the Mine Rock management protocols during the permitting process. The final MRMP will be developed based on the detailed engineering plans undertaken during the final design phase to be consistent with the environmental protection measures for the NICO Project.

### 3.1.2 QUANTITY AND DISTRIBUTION OF MINE ROCK

The primary study area for the MRMP is the mine and surface facilities at the NICO Project, including the tailings and Mine Rock Co-Disposal Facility (CDF), roadways, rock pads, and any other areas where rock will be disturbed or deposited during construction and operations (Figure 3.1.2-1). Rock will only be used for construction if it meets the geochemical criteria outlined in Section 3.1.5.2.

Table 3.1.2-1 presents a preliminary Mine Rock production schedule during the predicted mine life.

PLOT DATE: May 11, 2011  
 FILENAME: T:\Projects\2010\10-1118-0046 (FML, NWT)\-0A-\10111800460A0312-1.dwg



**LEGEND**

	PUMP STATION (MOTHBALLED, CONTINGENCY ONLY)
	DIVERSION DITCH
	PROJECT LEASE BOUNDARY
	WATERSHED
	ACCESS ROAD
	CO-DISPOSED TAILINGS AND MINE ROCK
	CONTINGENCY POND
	PERIMETER DYKE OF CO-DISPOSAL FACILITY
	RECLAIM POND
	SEEPAGE COLLECTION POND / SURGE POND
	WATER BODY

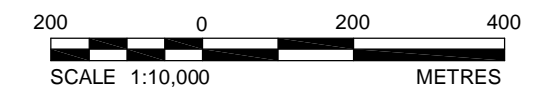
- NOTES**
1. All elevations (geodetic datum) and grid coordinates (UTM NAD 83, Zone 11) shown in this drawing are in metres.
  2. Configuration shown assumes sub-economic ore is not processed.

**REFERENCE**

Base mapping provided in digital format by Fortune Minerals Limited received 20 February 2004.

Process plant and mine infrastructure provided by Aker Solutions filename 0000g001d (plant site oct252010).dwg provided 26 October 2010. Revised pits provided by P & E Mining Consultants, ultimate pit and topo.dxf on 26 January 2010.

Project lease boundary provided by Fortune (October 8, 2008) with comments provided 19 December 2009.



	<b>FORTUNE MINERALS LIMITED</b> <b>NICO DEVELOPER'S ASSESSMENT REPORT</b>		
	<b>PROPOSED SITE LAYOUT</b>		
 Edmonton, Alberta	FILE No: E-MRM-001-CAD.dwg		
	PROJECT No: 09-1373-1004	SCALE AS SHOWN	REV. 0
	DESIGN IM 10 May 2011		
	CAD TDR 10 May 2011		
	CHECK IM 10 May 2011		
REVIEW KAB 10 May 2011			
<b>FIGURE: 3.1.2-1</b>			

Table 3.1.2-1: Distribution of Mine Rock by Operations Year

Year	Mined Ore and Mine Rock				Mine Rock for Dyke/dam Construction and Backfilling				Mine Rock for Co-disposal	Total Tailings Generated		Tailings Filling Mine Rock Void	Tailings Disposed in Cells	CDF Total Storage Capacity
	Mined Ore	Mine Rock	Sub-economic Mineralized Mine Rock	Total	Mine Rock for CDF Perimeter Dyke Construction	Mine Rock for Cemented Rock Backfill <sup>a</sup>	Mine Rock for Seepage Collection Dams Construction	Total		(t/y)	(m <sup>3</sup> /y)			
	(t/y)	(t/y)	(t/y)	(t/y)	(t/y)	(t/y)	(t/y)	(t/y)		(t/y)	(m <sup>3</sup> /y)			
0	318 355	1 187 553	62 592	1 568 500	593 863	0	236 200	830 063	420 082	306 894	176 697	32 734	143 963	670 688
1	1 698 410	4 836 979	118 496	6 653 885	429 853	132 869	0	562 722	4 392 753	1 637 267	942 669	342 292	600 377	3 105 626
2	1 698 409	8 843 957	331 897	10 874 263	923 543	44 290	0	967 833	8 208 021	1 637 266	942 668	639 586	303 082	5 046 752
3	1 698 408	9 214 204	657 469	11 570 081	776 076	0	0	776 076	9 095 597	1 637 265	942 668	708 748	233 920	5 362 062
4	1 698 408	9 939 869	250 579	11 888 856	776 076	0	0	776 076	9 414 372	1 637 265	942 668	733 587	209 080	5 502 820
5	1 698 408	6 489 199	304 433	8 492 040	776 076	0	0	776 076	6 017 556	1 637 265	942 668	468 900	473 767	4 002 927
6	1 698 408	5 527 876	416 552	7 642 836	1 094 134	0	0	1 094 134	4 850 294	1 637 265	942 668	377 ,945	564 723	3 652 737
7	1 698 408	5 777 623	166 805	7 642 836	1 094 134	0	0	1 094 134	4 850 294	1 637 265	942 668	377 945	564 723	3 652 737
8	1 698 408	5 517 507	426 921	7 642 836	1 094 134	0	0	1 094 134	4 850 294	1 637 265	942 668	377 945	564 723	3 652 737
9	1 698 408	4 482 004	190 164	6 370 576	1 094 134	0	0	1 094 134	3 578 034	1 637 265	942 668	278 808	663 860	3 090 960
10	1 698 408	5 625 017	319 411	7 642 836	352 798	0	43 800	396 598	5 547 830	1 637 265	942 668	432 298	510 369	3 575 631
11	1 698 408	4 540 589	554 635	6 793 632	352 798	0	0	352 798	4 742 426	1 637 265	942 668	369 540	573 128	3 219 998
12	1 698 408	4 763 402	331 822	6 793 632	352 798	0	0	352 798	4 742 426	1 637 265	942 668	369 540	573 128	3 219 998
13	1 698 408	4 363 639	391 903	6 453 950	352 798	0	0	352 798	4 402 744	1 637 265	942 668	343 071	599 597	3 070 008
14	1 698 408	3 536 821	709 199	5 944 428	352 798	0	0	352 798	3 893 222	1 637 265	942 668	303 368	639 300	2 845 025
15	1 698 408	1 244 946	419 494	3 362 848	352 798	0	0	352 798	1 311 642	1 637 265	942 668	102 206	840 462	1 705 106
16	1 698 408	1 397 294	267 146	3 362 848	352 798	0	0	352 798	1 311 642	1 637 265	942 668	102 206	840 462	1 705 106
17	1 698 408	1 450 688	213 752	3 362 848	352 798	0	0	352 798	1 311 642	1 637 265	942 668	102 206	840 462	1 705 106
18	1 698 408	1 540 064	294 783	3 533 255	352 798	0	0	352 798	1 482 049	1 637 265	942 668	115 484	827 184	1 780 351
19	150 682	102 654	41 431	294 767	0	0	0	0	144 085	145 257	83 633	11 227	72 406	147 255
<b>Total</b>	<b>31 040 384</b>	<b>90 381 885</b>	<b>6 469 484</b>	<b>127 891 753</b>	<b>11 827 205</b>	<b>177 159</b>	<b>280 000</b>	<b>12 284 364</b>	<b>84 567 005</b>	<b>29 922 930</b>	<b>17 228 354</b>	<b>6 589 637</b>	<b>10 638 717</b>	<b>60 713 631</b>

<sup>a</sup> Amount of mine rock for backfill may change as a function of mine plan.  
t/y = tonnes per year; m<sup>3</sup>/y = cubic metres per year; CDF = Co-Disposal Facility

Approximately 96.9 million tonnes (Mt) of Mine Rock will be produced during the proposed 18-year mine life. The Mine Rock production schedule includes 6.5 Mt of sub-economic mineralized Mine Rock. Sub-economic mineralized Mine Rock is Mine Rock that may become economic if parameters used in the reserve estimate change, such as an increase in metals prices or a decrease in operating costs. Sub-economic mineralized Mine Rock represents approximately 7 percent (%) of the total amount of Mine Rock to be produced during the mine life.

Less than 1% of the Mine Rock will be used for construction at the NICO Project, including aggregate for the cemented rockfill that will be used to backfill the stopes in the underground mine workings below the Open Pit (where stopes intersect the open pit and affect stability), and construction of roads and water management structures outside perimeter of the CDF. The remainder of the Mine Rock will either be used for construction of the perimeter embankments of the CDF, or will be co-disposed with tailings within the CDF perimeter embankments. Rock will be selectively used for construction based on its geochemical characteristics, as described in Section 3.1.5.2

### 3.1.3 SITE GEOLOGY AND MINERALIZATION

#### 3.1.3.1 Mineralization in the Ore Deposit

The NICO ore body is a Hydrothermal Iron Oxide-Hosted Replacement Deposit, also known as an IOCG type deposit. The ore deposit is located on the northern slope of a bowl shaped depression, referred to as the “Bowl Zone”. Ore generally occurs in 3 sub-parallel zones of iron-rich metasedimentary rocks (including ironstone and wacke). The mineralized zones are referred to as the Upper, Middle, and Lower Zones.

The NICO ore deposit was formed by metasomatism of the iron-rich, metasedimentary host rocks. Metasomatism is a type of metamorphism resulting from chemical alteration of a rock by a hydrothermal fluid. The mineralogy of the ore and waste zones was influenced by the sequence of mineral formation that occurred during five stages of metamorphic alteration.

During the first stage of alteration, metamorphism of the host rock (amphibolite wacke) resulted in the formation of sulphide minerals (including pyrite [FeS<sub>2</sub>] and pyrrhotite [Fe<sub>1-x</sub>S]) and iron oxide minerals (including magnetite [Fe<sub>2</sub>O<sub>3</sub>]). Iron oxide minerals that were formed during the first stage of metamorphic alteration form up to 20% of the mineralized zones.

The formation of copper and gold –bearing minerals occurred during the second stage of alteration. Copper occurs in chalcopyrite [CuFeS<sub>2</sub>] and copper sulphosalts. Gold occurs as native gold, and in association with bismuth telluride, bismuthinite [Bi<sub>2</sub>S<sub>3</sub>] and feldspar [KAlSi<sub>3</sub>O<sub>8</sub>].

Cobalt mineralization occurred during the third and fourth stages of alteration. Initially, cobalt was accumulated in cobaltite [(Co, Fe)AsS]. During the fourth stage of alteration, cobaltite reacted with metasomatic alteration fluids rich in arsenic. Widespread precipitation of cobalt-bearing arsenopyrite [FeAsS] and bismuthinite also took place. In the fifth stage of alteration, arsenopyrite became the primary sulphide precipitating from the metamorphic fluids.

As a result of the sequence of metamorphic alteration, certain minerals occur within restricted zones of higher grade mineralization within the NICO ore deposit, including native gold and native bismuth, and bismuth tellurides. Native gold and native bismuth occur as both disseminations, and as components of sulphide minerals. Similarly, the occurrence of cobalt-bearing minerals is not widespread. Minerals that are widespread

throughout the ore and waste zones include arsenopyrite, chalcopyrite, pyrrhotite and pyrite. Arsenopyrite occurs both in zones of higher grade mineralization and zones of weaker (i.e., non-ore grade) mineralization outside the ore body. Arsenopyrite and cobaltite are commonly aligned along foliation planes in the rock. Chalcopyrite, pyrrhotite and pyrite occur as localized fracture fillings and disseminations.

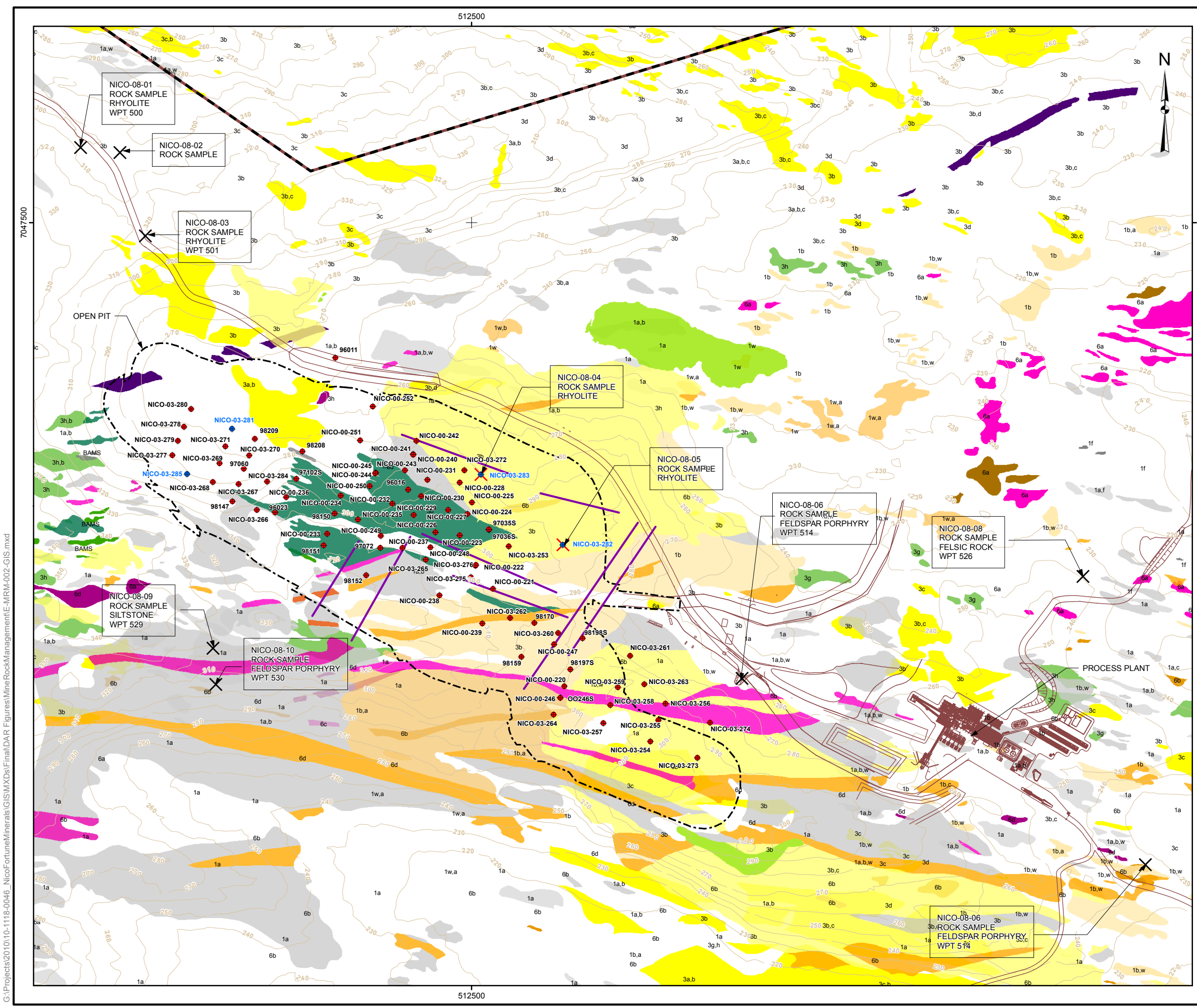
### 3.1.3.2 Geological Formations

Figure 3.1.3-1 presents the bedrock geology of the NICO Project area. Geological formations at the NICO Project include the following:

- feldspar porphyry;
- rhyolite;
- breccia;
- fault zone;
- ironstone (including black rock schist and wacke); and
- siltstone.

The main geological formation in the ore deposit is metasedimentary ironstone, which consists of minerals including iron rich biotite and amphibole, magnetite, hematite, and feldspar, with some chlorite and carbonate. Ironstone is operationally defined as “Black Rock Schist” at the NICO Project.

The metasedimentary rocks are overlain by rhyolite (a volcanic rock). Coarse-grained porphyritic dykes (feldspar porphyry and quartz-feldspar porphyry) crosscut the ore zone and surrounding rocks. Minor rock types at the NICO deposit are siltstone and breccia. The metasedimentary siltstone occurs in the footwall of the ore deposit. Breccia, which consists of a fragmental mixture of siltstone, wacke and volcanic rock, is found at or near the contact between the volcanic and metasedimentary rocks.



**LEGEND**

- INCLINED EXPLORATION HOLES WITH GEOCHEMISTRY SAMPLES
- ◆ INCLINED GEOTECHNICAL HOLES WITH GEOCHEMISTRY SAMPLES (GOLDER ASSOCIATES)
- ✕ OUTCROP ROCK SAMPLE LOCATION WITH GEOCHEMISTRY TESTING
- ✕ OUTCROP ROCK SAMPLE LOCATION WITH GEOCHEMISTRY TESTING AND SAMPLES FROM OUTCROP AT DRILLHOLE COLLARS
- PROJECT LEASE BOUNDARY
- PROPOSED NICO MINE SITE
- - - OPEN PIT
- CONTOUR (10 m INTERVAL)
- FAULTS

**GEOLOGY**

- QUARTZ VEINING
- 1B SUBARKOSIC ARENITE
- 1F CORDIERITE SCHIST
- 1W SUBARKOSIC WACKE
- 1A SILTSTONE
- BAMS BIOTITE-AMPHIBOLE-MAGNETITE SCHIST

**FABER LAKE VOLCANIC SEQUENCE**

FELSIC (RHYOLITE-RHYODACITE)

- 3A APHYRIC FLOWS
- 3B TUFF, < 2MM
- 3C LAPILLI TUFFS
- 3D LOCALLY BRECCIATED
- 3H,G HETEROLITHIC BRECCIAS, DEBRIS FLOW

**GREAT BEAR MAGMATIC ZONE**

SUBVOLCANIC INTRUSIONS

- 6D FELDSPAR-AMPHIBOLE PORPHYRY
- 6C QUARTZ PORPHYRY
- 6B QUARTZ-FELDSPAR PORPHYRY
- 6A FELDSPAR PORPHYRY

**REFERENCE**

Topographic mapping obtained from Eagle Mapping, Fortune Minerals Limited, 2006 (File: Basemapping FML, 20060718).dwg)

Open Pit Configuration - Provided by P & E Mining Consultants Inc. (File: End\_of\_year2031.dxf Received August 26, 2010)

Advanced Exploration Infrastructure - Provided by Aker Solutions (File: 0000g001D.dwg Received October 25, 2010)

Outcrop Bedrock Geology and Fault Lineation Interpretations provided by Fortune Minerals (2004).

Projection: UTM Zone11 Datum: NAD 83



FORTUNE MINERALS LIMITED  
NICO DEVELOPER'S ASSESSMENT REPORT

TITLE

**BEDROCK GEOLOGY OF THE NICO PROJECT AREA**

FILE No. E-PD-001-GIS.mxd

PROJECT NO. 09-1373-1004	SCALE AS SHOWN	REV. 0
DESIGN SC 16 Feb. 2011	<b>FIGURE: 3.1.3-1</b>	
GIS SC 9 May. 2011		
CHECK KS 9 May. 2011		
REVIEW MR 9 May. 2011		

Golder Associates  
Edmonton, Alberta

G:\Projects\2010\10-1118-0046\_NicoFortuneMinerals\GIS\MXDs\Final\DIR\Figures\MineRockManagement\ERM-002-GIS.mxd

### 3.1.4 GEOCHEMICAL CHARACTERISTICS OF MINE ROCK

All rock types expected to be encountered during construction and operation were evaluated in a geochemistry program that took place between 2004 and 2008. Over 300 samples of Mine Rock and sub-economic mineralized Mine Rock were collected from exploration drill core, surface outcrops, and stockpiles of resulting from the bulk exploration sample ramp (Figure 3.1.3-1). The samples that form the geochemical dataset for the NICO Project encompass the lateral and vertical extent of materials that will be excavated during mining. This section summarizes the results of the geochemical characterization program for the NICO Project. The Geochemical Characterization Report, Annex A of the DAR, provides a detailed discussion of the geochemical characterization of Mine Rock and sub-economic mineralized Mine Rock.

The results of geochemical characterization are a key component of the Mine Rock classification criteria. Geochemical stability can be broadly categorized into acid rock drainage and metal leaching. Acid rock drainage and metal leaching are generally related; however, metal leaching can occur independently from acid generation. The potential for acidity and metal release from the different rock materials was evaluated using standard geochemical test procedures, including analyses of solids and leachates (DIAND 1992; Price 1997; MEND 2009; INAP 2009).

Representative rock samples of the major geological formations at the NICO Project were submitted for geochemical characterization, including the following:

- Siltstone
- Breccia
- Wacke
- Black Rock Schist + Magnetite (BRS + mt)
- Rhyolite
- Black Rock Schist ± Magnetite (BRS ± mt)
- Quartz-Feldspar Porphyry (QAP)
- Fault Zone
- Feldspar Porphyry (FAP)

The following sections provide a brief overview of the acid generation potential and metal leaching potential of Mine Rock and sub-economic mineralized Mine Rock.

#### 3.1.4.1 Acid Generation Potential of Mine Rock

The geochemical characterisation program included several testing methods that were used to classify the acid generation potential of Mine Rock and sub-economic mineralized Mine Rock samples. The evaluation of the results of the geochemical characterization program indicated that most Mine Rock can be classified as non-potentially acid generating (non-PAG). Sulphide minerals represent the main source of acid potential (AP) in a sample. The range of sulphur concentrations in Mine Rock samples was <0.01 to 1.6% (median 0.05 %). Although Mine Rock has a low buffering capacity (i.e., low carbonate mineral concentrations), the sulphide concentrations in most samples were so low that the samples were not capable of generating acidic runoff or seepage. Mine Rock samples that contain elevated sulphur concentrations have a higher potential for acid generation. Sub-economic mineralized Mine Rock had a higher potential for acid generation owing greater higher sulphur concentrations (0.06 and 0.63%, median 0.38%). Table 3.1.4-1 summarizes the acid generation potential of samples in the geochemical dataset by rock type according to the results of acid base accounting.

**Table 3.1.4-1: Summary of the Acid Generation Potential of Mine Rock**

Lithology	Number of Samples (ABA)	Percentage of Samples with Acid Generation Potential (NP:AP <2)	Percentage of Samples with Acid Generation Potential (sulphide-sulphur >0.3%)
Feldspar Porphyry / Quartz Amphibole Porphyry	34	3%	0%
Rhyolite	40	33%	13%
Wacke / Black Rock Schist / Breccia	102	17%	15%
Siltstone	18	0%	0%
<i>Mine Rock</i>	<i>194</i>	<i>16%</i>	<i>10%</i>
Sub-economic Mineralized Mine Rock	20	55%	45%

AP = acid potential; NP = neutralization potential

The results of long-term kinetic tests presented in Annex A (Geochemistry Baseline) confirmed that samples of rock with low sulphur content have a low potential for acid generation. The results of kinetic tests provide rates for acid generation, acid neutralization, and metal release in laboratory conditions (i.e., enhanced leaching conditions). Of the 12 samples of Mine Rock submitted for kinetic testing, only 2 samples generated acidic leachate pH values in the duration of the tests.

The potential for acid generation of sub-economic Mine Rock samples is currently being evaluated using on-site field tests. Field tests were initiated in 2008; although all samples are considered potentially acid generating based on NP:AP ratio and sulphide-sulphur content, acidic pH values have not yet been measured in the field cell leachates.

### 3.1.4.2 Metal Leaching Potential of Mine Rock

A complete discussion of the solid phase metal concentrations and metal leaching potential of Mine Rock and sub-economic Mine Rock is presented in the Geochemical Characterization Report (Annex A).

Metal mobilization occurs as a result of mineral oxidation or dissolution that occurs during the physical and chemical weathering of rock. A detailed evaluation of the results of solid phase analysis indicated that many metals occurred in association with sulphide-sulphur, including arsenic, copper, cobalt, nickel, and zinc in Mine Rock and sub-economic Mine Rock samples. Other metals, including selenium, antimony, (and to a lesser extent, silver) occur in association with bismuth in Mine Rock and sub-economic Mine Rock samples.

The metal leaching potential of Mine Rock and sub-economic mineralized Mine Rock was evaluated based on the results of geochemical leach tests. The results of laboratory and field scale leach tests represent the range of potential geochemical conditions that could be realized during operations and closure at the NICO Project, including rapid flushing of solid phase samples that could be realized during precipitation events (short-term leach tests), metal release in oxidizing conditions (analysis of net acid generation test leachates), and longer-term metal leaching trends in laboratory (kinetic tests) and site conditions (field cells).

The results of geochemical leach tests were compared to the site specific water quality criteria for the purpose of identifying key leachate parameters. Key leachate parameters in Mine Rock included aluminum, arsenic, iron,

and copper. Key leachate parameters in sub-economic, mineralized Mine Rock were aluminum, arsenic, cadmium, cobalt, copper, iron, molybdenum, antimony, selenium, uranium, and zinc. Many of the metals are capable of leaching from Mine Rock and sub-economic mineralized Mine Rock in both neutral and acidic pH conditions.

### 3.1.5 MINE ROCK CLASSIFICATION

Identification of rock with a potential for acid generation and metal leaching is required during all stages of mine development for the purpose of short-term and long-term mine planning. This section discusses site-specific criteria for classifying rock during operations.

Mine Rock classification criteria were developed based on the results of geochemical characterization of Mine Rock and sub-economic Mine Rock (Annex A). In addition, over 17 000 samples were submitted for solid phase analysis during the exploration stage of the NICO Project. The results of solid phase analysis in the exploration dataset were used to support the assessment of acid generation and metal leaching potential. Using the combined geochemistry and exploration datasets allowed for direct comparison of the Mine Rock classification criteria to the mine block model for the NICO Project.

#### 3.1.5.1 Acid Rock Drainage and Metal Leaching Control Measures

Table 3.1.5-1 summarizes the criteria used for classification of Mine Rock samples. Attachment 3.1-I discusses the approach used to develop the site specific Mine Rock classification criteria were determined for the NICO Project.

##### 3.1.5.1.1 Classification of Acid Generation Potential

Several parameters were evaluated for used as operational control measures for acid generation potential, based on the results of static geochemical tests (i.e., NP:AP ratio, sulphide-sulphur content, and net acid generation (NAG) testing:

- **NP:AP Ratio:** The procedure involves separate determinations of acid neutralization potential (NP), which is a measure of the amount and availability of alkaline-producing minerals, and AP, a measure of reactive sulfides present. In concept, if the AP exceeds the NP, there is a potential for acid generation. An NP:AP ratio of 2 is often used to distinguish potentially acid generating rock, which represents a large factor of safety (MEND 2009).
- **Sulphide-sulphur content:** Sulphide minerals are the primary reactive source of acidity, metals, and sulfate in Mine Rock samples from the NICO Project. Measurement of the sulphur content is an indicator of the potential reactivity of a sample. Sulphide-sulphur can be obtained quickly and reliably on-site, which is a key requirement for an operational Mine Rock management tool. On-site measurement of sulphur content by Leco furnace is one of the most common methods used for operational classification of mine rock (MEND 2009).

## FORTUNE MINERALS LIMITED DEVELOPER'S ASSESSMENT REPORT

**Table 3.1.5-1: Summary of Rationale for Mine Rock Classification Criteria**

	Parameter	Criterion	Total Number of Samples	Number of Samples with Concentrations Less than the Proposed Criterion <sup>a</sup>	% of Available Dataset with Concentrations Less than the Proposed Criterion <sup>a</sup>	Rationale
Acid Generation Potential	Sulphide-sulphur	Less than 0.30%	293	237	81%	Rock containing greater than 0.3% sulphide-sulphur has a confirmed potential for acid generation based on the results of net acid generation testing and humidity cell testing.
Metal leaching potential	Arsenic	Less than 1000 ppm arsenic	6 921	3 334	48%	Rock containing greater than 1000 ppm arsenic report arsenic leachate concentrations greater than the MMER average monthly criterion (0.5 mg/L) and background concentrations in the Grid Ponds.
	Selenium	Less than 50 ppm bismuth	17 393	9 902	57%	Solid phase selenium concentrations correlate well with solid phase bismuth concentrations. The results of leach testing demonstrate that rock samples containing greater than 50 ppm bismuth leach selenium at concentrations greater than the site specific water quality criterion of 0.005 mg/L selenium.
Total number of samples containing less than 0.3% sulphide-sulphur, less than 1000 ppm arsenic and less than 50 ppm bismuth			<b>229</b>	<b>27</b>	<b>12%</b>	
Total number of samples containing less than 0.3% sulphide-sulphur and less than 1000 ppm arsenic			<b>229</b>	<b>128</b>	<b>56%</b>	
All remaining samples with either sulphide-sulphur greater than 0.3% or arsenic greater than 1000 ppm			<b>229</b>	<b>74</b>	<b>32%</b>	

<sup>a</sup> Total number of samples with concentrations less than the potential Mine Rock classification criteria.  
mg/L = milligram per Litre; ppm = parts per million; % = percent

- **NAG-pH:** The NAG test is a rapid, static method that involves the complete oxidation of sulphide minerals in a sample using hydrogen peroxide, and accompanying dissolution of all soluble minerals. The final NAG-pH reflects the balance of AP and NP in a sample after the complete reaction of the sample.

A reasonable agreement exists between the acid generation potential inferred by the NP:AP ratio, sulphide sulphur content and NAG-pH of Mine Rock and sub-economic mineralized Mine Rock samples submitted for geochemical characterization (Attachment 3.I-I). A sulphide-sulphur cut-off of 0.3% was selected for operational Mine Rock management.

### 3.I.5.1.2 Classification of Metal Leaching Potential

The evaluation of the results of geochemical leach tests suggested that metal leachability does not necessarily correlate with the sulphide sulphur content of a sample. The results of geochemical testing demonstrate many rock samples in the geochemical characterization dataset that are classified as “Non-PAG” have a metal leaching potential.

The evaluation of metal leaching potential presented in Attachment 3.I-I considered many of the key leachate parameters. Arsenic and selenium were identified as the 2 main metals for consideration in the context of the MRMP; no obvious criteria exist to classify rock with a high leaching potential for many of the other key metals.

Arsenic mineralization (i.e., the sulphide mineral arsenopyrite) occurs in many of the rock types at the NICO Project. The results of geochemical characterization suggest that a solid phase concentration cut-off of 1000 parts per million (ppm) arsenic could be used to identify rock that leaches arsenic at concentrations less than the Metal Mining Effluent Regulations (MMER) average monthly criterion for arsenic (0.5 mg/L), and background concentrations in the Grid Ponds (Attachment 3.I-I).

Solid phase concentrations of selenium occur in association with bismuth mineralization. Solid phase concentrations of selenium seem to be restricted to zones of high bismuth mineralization. Neither selenium nor bismuth solid phase concentrations are related to solid phase concentrations of sulphide sulphur or arsenic. As such, a third criterion is proposed to distinguish rock with a low selenium leaching potential. Based on the existing dataset, a solid phase concentration of 50 ppm bismuth could be used at to conduct a preliminary assessment of the volume of rock with a selenium leaching potential.

### 3.I.5.2 Geochemical Criteria for Management and Placement of Mine Rock

The Mine Rock classification criteria provide the basis for use of materials for construction of site facilities during operations and closure (Table 3.I.5-2).

Most Mine Rock, and all sub-economic mineralized Mine Rock, will be contained within the perimeter embankments of the CDF. A small portion of the Mine Rock will be used for the purpose of site construction outside of the CDF, such as the Surge Pond dams, Seepage Collection Pond (SCP) dams, and roads, rock pads, and lay down areas within the Mineral Processing Plant (Plant) site. Decision criteria have been developed based on the results of geochemical characterization for the purpose of classification of Mine Rock during mining at the NICO Project.

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**Table 3.1.5-2: Decision Criteria for Mine Rock Management at the NICO Project**

Classification	Criteria	Description
Cover Construction Material	Glacial till / sand	Cover construction material with a low potential for acid generation and metal leaching, and the required grain size characteristics to meet the objectives of the closure cover.
Type 1	Samples that contain: < 0.3% sulphide sulphur < 50 ppm bismuth < 1000 ppm arsenic	Rock with a low potential for acid generation and metal leaching to be used for construction of surge pond dams, seepage collection pond dams, roads, rock pads and lay down areas.
Type 2	Samples that contain: < 0.3% sulphide sulphur < 1000 ppm arsenic	Rock with a low potential for acid generation, to be used for construction of perimeter dykes within the CDF.
Type 3	Samples that contain either: > 0.3% sulphide sulphur > 50 ppm bismuth > 1000 ppm arsenic	Potentially acid generating and metal leaching rock, to be contained within the CDF. For the purposes of preliminary planning, Type 3 rock should be placed with a minimum 20 m offset from the exterior of the perimeter embankments of the CDF.
Sub-economic Mine Rock	Classified according to Fortune's grade control cut-offs	Sub-economic Mine Rock will be placed in segregated stockpiles located only within the areas of the pile that will be covered, at a suitable distance offset from the exterior slopes of the facility.

CDF = Co-Disposal Facility; ppm = parts per million; < = less than; > = greater than; % = percent

The Mine Rock classification criteria have been considered in the context of the CDF Management Plan (Appendix 3.II) and Water Management Plan (Appendix 3.III) for the NICO Project. All contact water from the CDF will be pumped to the Surge Pond for treatment. The perimeter embankments of the CDF will be constructed using Type 2 Mine Rock, which has a low potential for acid generation. Type 3 Mine Rock and sub-economic mineralized Mine Rock with a greater potential for acid generation and metal leaching will be effectively be encapsulated within the perimeter of the CDF. A closure cover will be constructed on the CDF using glacial till and sand. Closure cover materials must have a low potential for acid generation and metal leaching; this material must also meet the required grain size characteristics to meet the objectives of the closure cover.

Site infrastructure will only be constructed using Type 1 Mine Rock, which has a low potential for acid generation and metal leaching. Stockpiling of Type 1 material coupled with operational monitoring will be carried out to ensure that the rock used for construction meets the objectives of the Type 1 Mine Rock. At closure, any zones of rock fill in the site infrastructure (i.e., roads, laydown pads, and building foundations) that are problematic from a geochemical perspective will either be moved to the CDF or covered in place with soil. This will limit the potential for long-term weathering of Mine Rock used for the purpose of site construction.

### 3.1.5.2.1 Mine Rock Production Schedule

Table 3.1.5-3 presents a preliminary estimation of the Mine Rock production schedule in the context of the proposed Mine Rock classification criteria. The Mine Rock production schedule includes an evaluation of the total mass of rock with a combined low potential for acid generation and metal leaching.

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**Table 3.1.5-3: Preliminary Mine Rock Production Summary**

Sulphide-Sulphur Content	Estimated Tonnage <sup>a</sup>			Total Mine Rock Tonnages <sup>b</sup>	
	<0.3%		<0.3%	Mine Rock	Sub-economic Mineralized Mine Rock
	Bismuth Content	<50 ppm	<50 ppm		
	Arsenic Content		<1000 ppm		
Year 1	1 275 412	419 900	197 296	1 019 513	58 877
Year 2	4 749 594	2 730 550	1 210 431	4 898 390	110 416
Year 3	7 696 083	3 165 486	1 020 565	7 751 431	285 586
Year 4	11 973 095	5 155 147	2 579 658	11 193 692	676 627
Year 5	10 322 302	6 647 836	3 668 388	10 048 962	254 404
Year 6	7 299 347	3 878 730	1 822 596	6 274 724	312 153
Year 7	6 379 712	3 819 390	1 924 929	6 142 827	282 159
Year 8	6 503 804	3 849 622	1 975 131	6 334 860	260 530
Year 9	5 999 813	3 907 045	2 278 094	5 917 521	323 976
Year 10	5 034 389	2 914 227	1 963 420	4 748 152	267 470
Year 11	5 364 186	2 943 865	1 883 961	4 894 501	377 169
Year 12	5 843 061	2 895 516	1 699 550	5 664 242	540 102
Year 13	4 051 726	2 124 413	767 512	5 090 228	337 110
Year 14	3 420 996	2 050 381	378 569	5 312 509	410 499
Year 15	3 144 801	1 039 899	243 295	3 991 675	650 796
Year 16	1 167 657	1 167 657	133 077	1 508 183	462 112
Year 17	1 926 132	1 192 298	398 913	1 760 747	253 621
Year 18	1 817 368	1 064 553	342 683	1 899 878	327 120
Year 19	1 883 685	1 278 488	495 467	2 238 879	242 060
Year 20	122 320	92 867	6 838	109 144	36 696

<sup>a</sup> Tonnages provided by P&E Mining Consultants on 2 July 2010. The estimate tonnage of rock represents the total tonnage of rock according to the defined geochemical characteristics.

<sup>b</sup> Total tonnage of Mine Rock produced each year, based on the production schedule provided by P&E Mining Consultants on 9 July 2010. ppm = parts per million; < = less than; % = percent

The Mine Rock production schedule will be updated based on the final mine plan for the NICO Project. Updates will be made to the Mine Rock production schedule during the life of mine for the purpose of short and long-term planning.

### 3.1.6 PROPOSED MINE ROCK MONITORING AND TESTING PLAN

Mine Rock will be classified using laboratory methods that will be undertaken as part of a routine monitoring program. The primary objective of the MRMP is to minimize the potential for acid generation and metal leaching from Mine Rock, by ensuring that the rock used for construction of the site infrastructure adheres to the guidelines in the MRMP and CDF Management Plan (Appendix 3.III). A monitoring program is proposed that will effectively and efficiently classify Mine Rock and sub-economic Mine Rock during operations.

Mine Rock monitoring will be conducted as a part of operational mine planning. A preliminary Mine Rock schedule will be developed on a weekly basis. The weekly plan will be confirmed with the results of operational monitoring, and if necessary, modified based on the results of daily analytical testing. Results analysis of sulphide-sulphur, arsenic and bismuth analysis (measured at the on-site laboratory) will be used for classification of Mine Rock. The results of analytical monitoring will be incorporated into the plan for the following week.

Fortune will continue to refine the Mine Rock monitoring and testing plan outlined in this section during the permitting process and operations as a part of the environmental management protocols for the NICO Project.

### 3.1.6.1 Development of Standard Operating Procedures

Standard operating procedures will be required as part of the overall quality control for the NICO Project:

- planning;
- sample collection;
- sample analysis; and
- material flagging and relocation.

The standard operating procedures will be developed during the permitting process and detailed engineering design. The standard operating procedures will be updated as required according to the environment management protocols for the NICO Project.

### 3.1.6.2 Planning

A weekly development plan will be prepared as part of operational mine planning using the mine block model. The weekly development plan will identify:

- amount, lithology, and classification of Mine Rock to be mined at each heading in the coming week based on the mine model;
- preliminary determination of development rock that will be encountered in the subsequent week; and
- a compilation of daily analytical results of Mine Rock sample analysis, comparing the expected and observed conditions for the current and subsequent week.

### 3.1.6.3 Sample Collection and Analysis

Samples will be collected from each development heading in the underground mine workings and Open Pit at a frequency that complements the ore grade control and environmental performance criteria for the NICO Project. It is anticipated that the sample frequency will be defined during the permitting process.

Samples will be submitted to the on-site assay laboratory for analysis. The analytical methods used to classify Mine Rock were selected to satisfy the following operational criteria:

- the analytical test must reliably identify the sulphide-sulphur, arsenic, and bismuth content of Mine Rock; and
- the test must be capable of producing information that can be used for operational decision making within a timeframe amenable to the operational time frame.

It is anticipated that acid generation potential will be defined using a sulphide-sulphur assay, which will likely be analyzed using a Leco furnace analyzer at the on-site assay laboratory. The Leco furnace is capable of measuring both total-sulphur and other sulphur species (following the appropriate digestion of the sample).

Bismuth and arsenic analysis will likely be completed by acid digestion followed by atomic adsorption spectrophotometry.

The final analytical methods will be defined and calibrated to achieve suitable results at a detection limit suitable for classification according to the Mine Rock management criteria in Table 3.1.5-2.

### 3.1.6.4 Comparison to Mine Rock Management Criteria

The results of analysis of Mine Rock samples will be provided to the mine geologist. The mine geologist will compare the results of analysis to the Mine Rock classification criteria in Table 3.1.5-2. The mine geologist will use the results of this comparison to confirm the properties of material in each muck pile.

### 3.1.6.5 Physical Handling of Mine Rock

After the mine geologist has confirmed the properties of Mine Rock in each muck pile, the muck pile will be flagged using a coded colour scheme. The operators will be made aware of colour codes and material designations. The material will be used for general site construction, or placed within the CDF based on the criteria in Table 3.1.5-2.

Approximately 19% of the samples in the combined geochemistry/exploration dataset contain greater than 0.3% sulphide-sulphur (i.e., Type 3 Mine Rock). However, it is likely that greater 19% of the overall tonnage of Mine Rock will require segregation as Type 3 Mine Rock:

- Samples with uncertain analytical results are typically conservatively treated as PAG.
- Generally, small samples are used to classify large rock masses during operations. If 1 or 2 PAG samples are identified in a blast, the entire blast will likely be classified as PAG rock.

The standard operating procedures will provide a detailed outline of this procedure, including the parties responsible for proper placement of material and tracking of material placement. The procedures will be developed as a component of the operational management system for the mine, and refined during operations in accordance with the requirements of the environmental management system.

### 3.1.6.6 Quality Assurance/Quality Control

A detailed quality assurance/quality control protocol will be established as part of the standard operating procedures for the mine. Quality assurance/quality control procedures could include the following:

- laboratory specific procedures for analysis;
- collection of duplicate samples;
- confirmation sampling and analysis; and
- inspection of the classification and placement of Mine Rock.

### 3.1.7 OVERBURDEN CLASSIFICATION

The NICO Project site has rugged topography. Rock outcrops are common in hilly parts of the NICO Project area. Overburden is common in the valley bottoms, consisting of the following stratigraphic sequence:

- Organics (peat and organic soils)
- Silts and Clays (glacio-lacustrine deposits)
- Granular deposits including beach sediment, glacial till or cobble and boulder materials

The CDF and water management facilities will be cleared of vegetation prior to mining and site development. Stripping of organics will be limited to the footprints of the Surge Pond dam, SCP dams, and the starter dyke for the CDF Perimeter Dyke.

The foundation areas of the CDF Perimeter Dykes, Surge Pond dams, and SCP dams will first be stripped of organics. Organic materials suitable for reclamation will be stored in the Growth Media Stockpiles.

Unsuitable overburden will be excavated from key trench zones. Samples of granular deposits removed during the construction phase will be tested to ensure suitability for construction of site roads, building laydowns and foundations, and the outer embankments of the SCP dams.

Several potential overburden borrow locations have been identified at the NICO Project site. The sequencing of these sources will be determined as part of detailed engineering.

The following sections provide an overview of the overburden material requirements for the NICO Project, and the borrow material sampling and testing plan. Fortune will continue to refine the overburden monitoring and testing plan outlined in this section during the permitting process and operations as a part of the environmental management protocols for the NICO Project.

#### 3.1.7.1 Overburden Requirements

Granular material and/or quarried bedrock will be required for construction during operations and closure. Organic material will also be required for reclamation purposes. Table 3.1.7-1 outlines overburden requirement quantities.

**Table 3.1.7-1: Placement and Quantities of Aggregate Required during Operations and Closure**

Deposition Location	Total Volume
SCP dams (bedding, road surface, filter, and key trench)	67 500 m <sup>3</sup>
Site road construction	0.15 M-m <sup>3</sup>
CDF Perimeter Dyke start-up filter	16 700 m <sup>3</sup>
Till stockpiled for CDF reclamation	1.11 M-m <sup>3</sup>
Sand for CDF capillary break cover	0.14 M-m <sup>3</sup>

SCP = Seepage Collection Pond; CDF = Co-disposal Facility; m<sup>3</sup> = cubic metre; M-m<sup>3</sup> = million cubic metre

### 3.1.7.2 Overburden Sampling and Testing Plan

The standard operating procedures for the borrow material sample collection and analysis plan will be developed during the permitting process and detailed engineering design. The standard operating procedures will be updated as required according to the environment management protocols for the NICO Project.

Overburden, including organics, overburden soils, and quarried bedrock will be sampled, analyzed, and classified according to the criteria outlined in Table 3.1.5-1:

- Organics and overburden that will be used for final site reclamation must, at a minimum, meet the requirements of Type 1 material.
- Material that will be used for general site construction (i.e., site roads, building foundations, rock pads, laydowns, and the Surge Pond and SCP dams must meet the requirements of Type 1 material.
- Material that will be used for construction of the perimeter embankments of the CDF must, at a minimum, meet the criteria of Type 2 material.

In addition, the borrow material analysis program must account for the physical characteristics of overburden, as material required for closure and reclamation will require certain grain size characteristics to meet the final design objectives of the closure cap. This requirement of the sampling and testing plan will be further outlined as a part of the detailed engineering design for the NICO Project.

### 3.1.8 PERFORMANCE MONITORING

The metal leaching potential of Mine Rock can be strongly influenced by environmental geochemical conditions, such as pH and redox; therefore, limiting the volume of potential metal leaching rock used to general construction of site infrastructure at the NICO Project is a conservative and sound environmental practise. However, the results of leach testing and background concentrations suggest that metals may mobilize from rock that contains even low concentrations of key metals such as arsenic and selenium. In addition to the Mine Rock management criteria, the Water Management Plan (Appendix 3.III) accounts for the management of contact water from site infrastructure. Water quality monitoring will be required during operations to confirm the metal leaching potential of the materials used to construct site facilities. Modification of the metal leaching criteria may be required based on the results of site-specific monitoring during operations.

Mine Rock contact water quality will be assessed as part of the environmental monitoring program for the NICO Project. It is anticipated that the requirements for water quality monitoring will be defined as part of the permitting process. During operations, the water quality data from all site runoff and seepage samples will be examined and evaluated by a qualified hydrogeochemist on an annual basis for trends indicative of incipient acid generation or metal leaching (e.g., elevated concentrations of key metals relative to baseline conditions, increases in acidity or alkalinity, increases in sulphate concentrations).

Monitoring of Mine Rock contact water quality will continue after closure. The results of water quality monitoring will be reviewed for the presence of metals and/or parameters indicative of signs of incipient acid generation and metal leaching.

### 3.1.9 REPORTING

Mine Rock management activities will be summarized as part of the annual reporting for the NICO Project. Annual reporting requirements will be defined as part of the permitting process. Data summaries could include the following:

- recorded Mine Rock volumes;
- descriptions of Mine Rock placement during the past year;
- a factual summary of the results of Mine Rock sample collection and analysis;
- evaluation of the results of Mine Rock sample analysis relative to the geochemistry dataset (Annex A);
- results of seepage water quantity and quality monitoring;
- evaluation of trends in seepage quantity and quality;
- results of the annual third party Mine Rock management inspection;
- recommendations for modifications to the Mine Rock management procedures based on the results of operational monitoring; and
- recommendations for ongoing adaptive management based on the results of operational monitoring.

The annual reporting requirements will be defined and updated based on the permitting process.

### 3.1.10 REFERENCES

DIAND (Department of Indian and Northern Affairs). 1992. Guidelines for ARD Prediction in the North. Department of Indian and Northern Affairs. September 1992.

INAP (The International Network for Acid Prevention). 2009. Global acid rock drainage guide (GARD Guide). <http://www.gardguide.com/>

MEND. 2009. Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials. MEND Report 1.20.1.

Price, W.A. 1997. Draft guidelines and recommended methods for the prediction of metal leaching and acid rock drainage at minesites in British Columbia. Reclamation Section, Energy and Minerals Division, British Columbia Ministry of Employment and Investment. April 1997.

# ATTACHMENT 3.I-I

## Evaluation of Mine Rock Management Criteria

### 3.I-I.1 INTRODUCTION

Site-specific criteria proposed for managing Mine Rock have been developed based on available geochemical characterization data for the NICO Project at the time of preparation of the MRMP in April, 2011. The results of geochemical characterization are commonly used to develop rock management criteria, allowing for informed engineering and site planning decisions based on specific knowledge of site conditions. The results of geochemical testing were considered in the context of commonly used guidance documents for the evaluation of acid generation and metal leaching (i.e., Price 1997; MEND 2009) to develop site-specific criteria for the segregation of rock with a high potential for acid generation and/or metal leaching.

### 3.I-I.2 GEOCHEMICAL CHARACTERIZATION DATA

The 2 datasets used to conduct the assessment of potential Mine Rock classification criteria include the geochemical characterization dataset (Annex A) for the NICO Project and the resource block model dataset (P&E Mining Consultants, 2010, pers. comm.) (Table 3.I-I.2-1). The geochemical characterization dataset includes samples of exploration drill core and Mine Rock collected from the NICO Project site. The resource block model dataset provided by P&E Mining Consultants includes the results of analysis of select metals and total sulphur conducted on samples of exploration drill core collected by Fortune exploration geologists.

Data pertinent to the evaluation of the acid rock drainage and metal leaching potential of Mine Rock at the NICO Project includes the following:

- acid base accounting, including measurement of total sulphur and sulphur speciation, NP, carbonate neutralization potential, and calculation of AP, and the NP:AP ratio;
- NAG testing, including measurement of the NAG pH;
- trace rock/whole metal analysis;
- short-term leach testing (i.e., shake flask extraction and synthetic leachate precipitation procedure);
- kinetic testing (humidity cell testing); and
- field scale leach testing.

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**Table 3.1-I.2--1: Summary of Geochemical Characterization Dataset**

	Total Sulphur	Acid Base Accounting	Comprehensive Trace Metal Analysis	Net Acid Generation Testing	Short-Term Leach Testing			Kinetic Testing	
					Comprehensive Analysis of NAG Leachates	Shake Flask Extraction	Synthetic Precipitation Leaching Procedure	Humidity Cell Tests	Field Cells
Feldspar amphibole porphyry	44	44	44	4	3	4	10	2	1
Quartz amphibole porphyry	2	2	2	1	0	0	1	0	0
Rhyolite	46	46	46	2	2	0	11	3	0
Siltstone	19	19	19	0	0	0	8	1	0
Wacke / Black Rock Schist	129	129	129	16	9	23	37	5	3
Breccia	13	13	13	0	0	0	4	1	0
Ore	61	61	61	19	8	43	11	0	1
<b>Total</b>	<b>314</b>	<b>314</b>	<b>314</b>	<b>42</b>	<b>22</b>	<b>70</b>	<b>82</b>	<b>12</b>	<b>5</b>

Note: Comprehensive trace metal analysis  
NAG = net acid generation

	Total Sulphur	Acid Base Accounting	Metal Analysis <sup>a</sup>			
			Comprehensive Trace Metal Analysis	Bismuth/Cobalt/Copper /Gold	Arsenic	Nickel/Selenium/Zinc/Gold/Tellurium
Feldspar amphibole porphyry	312	5	312	312	312	5
Quartz amphibole porphyry	283	2	283	283	283	2
Rhyolite	850	6	850	850	850	6
Siltstone	917	10	917	917	917	10
Wacke / Black Rock Schist	8 037	31	8 037	8 037	8 037	35
General Waste	981	0	981	981	981	0
Ore	5 743	8	5 743	5 743	5 743	15
<b>Total</b>	<b>17 123</b>	<b>62</b>	<b>17 123</b>	<b>17 123</b>	<b>17 123</b>	<b>73</b>

<sup>a</sup> Select metals analyzed during various stages of the exploration program.

### 3.I-1.3 OVERVIEW OF RESULTS OF GEOCHEMICAL CHARACTERIZATION OF MINE ROCK

The results of geochemical characterization of Mine Rock, sub-economic ore and ore were used to develop an overall evaluation of the acid rock drainage and metal leaching potential of mine wastes that could be generated during operations at the NICO Project. The distribution of potentially acid generating materials and the distribution of potentially metal leaching Mine Rock with respect to the mine production schedule are key factors that could influence the overall Mine Rock management strategies at the NICO Project.

This section provides an overview of the results of geochemical characterization of Mine Rock, including the baseline geochemical characterization and data available in the resource block model dataset.

#### 3.I-1.3.1 Acid Generation Potential

The acid generation potential of samples of Mine Rock, sub-economic ore and ore was evaluated using the results of acid base accounting and NAG testing, and humidity cell testing in the context of measures commonly used to determine the acid generation potential of mining materials. The purpose of this evaluation was to identify site-specific criteria that could be used to classify PAG Mine Rock at the NICO Project. Table 3.I-1.3-1 summarizes the relevant acid base accounting parameters in the geochemistry and resource block model datasets, respectively.

**Table 3.I-1.3-1: Summary of Acid Generation Potential of Mine Rock Samples**

	Criteria	Sulphide-Sulphur		NAG-pH		NP:AP				
		n	<0.3%	> 0.3%	n	>4.5	<4.5	n	>2	<2
Interpretation <sup>a</sup>			Non-PAG	PAG		Non-PAG	PAG		Non-PAG	PAG
Rock Type <sup>b</sup>	Dataset <sup>c</sup>									
FAP	Geochemistry	35	100%		4	100%		35	97%	3%
	Resource Block Model	5	80%	20%						
QAP	Geochemistry	2	100%		1	100%		2	100%	
	Resource Block Model	2	100%							
Rhyolite	Geochemistry	35	91%	9%	2	100%		35	74%	26%
	Resource Block Model	6	67%	33%						
Siltstone	Geochemistry	18	100%					18	100%	
	Resource Block Model	10	100%							
Wacke / BRS	Geochemistry	99	82%	18%	16	44%	56%	99	77%	23%
	Resource Block Model	31	81%	19%						
Breccia	Geochemistry	10	80%	20%				10	90%	10%
General Waste	Resource Block Model									
Ore <sup>d</sup>	Geochemistry	32	41%	59%	19		100%	32	25%	72%
	Resource Block Model	8	38%	63%						
<b>Total</b>		293	237	56	42	14	28	231	173	57
			81%	19%		33%	67%		75%	25%

<sup>a</sup> Classification based on recommendations in Price (1997) and MEND (2009)

<sup>b</sup> Dominant rock type in sample interval

<sup>c</sup> Geochemistry dataset summarized in the Geochemistry Report (Annex A of the DAR) . Resource Block Model dataset provided by P&E Mining Consultants, 19 April 2010.

<sup>d</sup> The acid generation potential of tailings is less than the acid generation potential of ore, due to the removal of sulphide minerals during processing.

The acid generation potential of a sample is a function of the sulphur content of a sample, as the oxidation of sulphide minerals can result in the release of acidity, sulphate and trace metals to contact water. As such, measurement of sulphur content by Leco furnace is a common method used for operational classification of Mine Rock at mine sites, as discussed in Price (1997) and MEND (2009).

As demonstrated in Figure 3.I-I-1, sulphide sulphur is the dominant sulphur species in Mine Rock at the NICO Project. Therefore, it is appropriate to assume that sulphide sulphur is the source of reactive sulphur in Mine Rock samples for the purpose of Mine Rock classification. This approach is consistent with the recommendation of INAP (2009). As summarized in Table 3.I-I.3-1, 42 out of 231 samples in the geochemistry dataset contained greater than 0.3% sulphide sulphur, a commonly used cut off for acid generation potential. A total of 14 out of 62 samples in the resource block model dataset contained greater than 0.3% sulphide sulphur. A total of 19% of the Mine Rock samples in the combined dataset contained greater than 0.3% sulphide sulphur.

The NAG test was used to confirm the acid generation potential inferred by the results of sulphur analysis. The NAG test is a rapid, static method that involves the rigorous, and usually complete oxidation of sulfide minerals present in a sample using hydrogen peroxide. If sufficient sulphide minerals are present, this reaction results in the generation of acidity and accompanying dissolution of soluble constituents. The final NAG pH of a sample reflects the “terminal” characteristics of that material; the results of NAG testing provide a conservative approximation of acid generation potential, as the procedure is designed to rapidly oxidize all reactive sulfide in a sample. The NAG test follows a relatively simple methodology that can be completed in a short time frame (typically less than 24 hours), making it a favourable potential method for operational Mine Rock classification. Samples with a NAG-pH less than 4.5 are considered to have a high potential for acid generation, owing to a lack of buffering capacity relative to the acid generation potential of a sample.

Net acid generation testing was carried out on a subset of samples in the geochemistry dataset collected from run-of-Mine Rock stockpiles after the initial geochemical characterization effort. The results of NAG testing are a tool for the confirmation of the acid generation potential inferred by the results of acid base accounting. As presented in Figure 3.I-I-2, the results of NAG testing suggest that a sulphide sulphur concentration of 0.3% could be used to distinguish PAG from non-AG material. Samples with a NAG pH less than 4.5 containing greater than 0.3% sulphide are considered PAG (i.e., upper right hand quadrant of Figure 3.I-I-2).

The NP:AP ratio is another commonly-used indicator of the static potential of acid generation of a sample. An NP:AP ratio of 2 is commonly used to distinguish PAG from non-acid generating (non-AG) rock, which represents a reasonable factor of safety. NP/AP ratio is evaluated in the context of NAG-pH in Figure 3.I-I-3: samples with NP:AP ratios less than 2 and NAG-pH less than 4.5 are considered PAG. Figure 3.I-I-4 presents a well-defined trend between NP/AP ratio and sulphide sulphur content: samples with an NP:AP ratio less than 2 containing greater than 0.3% sulphide sulphur have a potential for acid generation.

Table 3.I-I.3-2 summarizes the results of humidity cell testing carried out on 12 samples of Mine Rock. Samples containing greater than 0.3% sulphide sulphur with NP/AP ratios less than 2 generated acidity during the testing period.

## FORTUNE MINERALS LIMITED DEVELOPER'S ASSESSMENT REPORT

**Table 3.1-I.3-2: Results of Humidity Cell Testing**

Sample ID	NP:AP Ratio	Sulphide-Sulphur Depletion			NP Depletion			Acid Generation Potential	Arsenic (ppm)	Arsenic mg/L <sup>b</sup>
		Sulphide-Sulphur	Depletion Rate	Time to Depletion	NP	Depletion Rate	Time to Depletion			
		%	mg/kg/week	Years	t CaCO <sub>3</sub> / 1000 t	mg/kg/week	Years			
<b>Feldspar Porphyry</b>										
100859	20	0.02	0.16	24	12	6	41	Non-acid generating	21	0.008
100913	13	0.04	0.16	48	16	7	41	Non-acid generating - negligible sulphide content	65	0.007
<b>Rhyolite</b>										
100863	36	<0.01	0.16	8	11	4	45	Non-acid generating	200	0.05
100932	0	0.5	2.0	45	0	N/A <sup>a</sup>	N/A	Acid generating - Acid generation realized during kinetic testing.	200	0.002
100872	40	0.01	0.18	10	12	8	29	Non-acid generating	36	0.01
<b>Breccia</b>										
100925	28	0.01	0.16	8	9	1	148	Non-acid generating	200	0.0094
<b>Black Rock Schist (+ magnetite)</b>										
100890	11	0.03	0.16	34	10	2	84	Non-acid generating	1700	0.12
100977	11	0.04	0.16	46	14	3	90	Non-acid generating	1100	0.01
<b>Black Rock Schist (± magnetite)</b>										
100802	91	<0.01	0.16	11	28	2	246	Non-acid generating	41	<0.005
100907	1	0.3	0.18	285	10	0	514	Acid generating - Acid generation realized during kinetic testing.	5100	0.03
<b>Sub-Arkosic Wacke</b>										
100881	27	0.02	0.16	8	10	1	165	Non-acid generating	38	0.04
<b>Siltstone</b>										
100914	31	<0.01	0.16	24	17	4	85	Non-acid generating	5	0.0003

t = tonnes; mg/kg = milligrams per kilogram; % = percent

<sup>a</sup> Initial NP is zero and therefore these calculations cannot be completed.

<sup>b</sup> Average concentration over last five weeks of testing.

### 3.I-3.2 Metal Leaching Potential

A complete discussion of the distribution of solid phase metal concentrations and metal leaching potential of Mine Rock, sub-economic Mine Rock, and ore is presented in Annex A. Metal leaching potential is discussed in the context of the mineralogical hosts of metals in Mine Rock samples in the combined geochemistry and resource block model datasets, and the metal leaching potential inferred by the results of baseline geochemical characterization.

#### 3.I-3.2.1 Solid Phase Metal Distribution in Mine Rock

The geological model for the ore deposit at the NICO Project suggests that the distribution of solid phase metal concentrations in Mine Rock, sub-economic Mine Rock, and ore is a function of the metamorphic alteration of the host rock. Certain minerals occur within restricted zones of higher grade mineralization within the NICO ore deposit, including native gold and native bismuth, and bismuth tellurides [Bi<sub>2</sub>Te<sub>3</sub>]. Native gold and native bismuth occur as disseminations, and in association with sulphide minerals. Similarly, the occurrence of cobalt-bearing minerals is not widespread. Arsenopyrite occurs both in zones of higher grade mineralization and zones of weaker (i.e., non-ore grade) mineralization outside the ore body. Arsenopyrite [FeAsS] and cobaltite [Fe(Co,As)S] are commonly aligned along foliation planes in the rock. Chalcopyrite [CuFeS<sub>2</sub>], pyrrhotite [Fe<sub>1-x</sub>S] and pyrite [FeS<sub>2</sub>] occur as localized fracture fillings and disseminations.

The results of solid phase analysis of samples in the geochemistry and resource block model datasets were evaluated to confirm the elemental associations suggested by the geologic model for the ore deposit. Statistical correlation was used to determine elemental associations. When supplemented with the known mineralogy of a rock type, elemental associations can be used to infer the mineralogical host of trace metals. The results of the statistical analysis are presented as correlation coefficients (R) between 2 metals. The correlation coefficient is a ratio that relates the covariance of 2 independent variables. A correlation coefficient of 1 indicates a direct relationship between 2 variables, and -1 indicates an inversely proportional relationship (Davis 1986). The typical interpretation of the correlation coefficient uses a cut-off 0.75 / -0.75 to infer a statistically meaningful correlation. Statistical correlations were completed by combining the geochemistry and resource block model datasets, and grouping samples by lithology. An initial iteration of the correlation scenarios indicated that solid phase detection limit values for selenium were influencing the results of statistical correlation. Solid phase selenium concentrations below the analytical detection limit values were removed from the dataset, and statistical correlations were re-evaluated. Attachment 3.I-1a presents the results of statistical correlation on the combined geochemistry/resource block model datasets.

The results of the statistical correlation evaluation confirm the geologic description of the deposit. Two key groupings of elements exist, metals that are associated with sulphide mineralization, and elements that are associated with bismuth mineralization.

Metal sulphides are ubiquitous in mineralized rock at the NICO Project. Element correlations suggest cobalt is primarily associated with arsenic and sulphide in Mine Rock, indicating the potential occurrence of arsenic-bearing cobalt sulphides (i.e., cobaltian arsenopyrite and cobaltite). Nickel and iron are associated with cobalt in several of the rock types including QAP dykes and rhyolite. Both nickel and iron can incorporate into the structure of cobaltite (Barkov et al 2002), and conversely, cobalt can incorporate into iron and nickel sulphides including pyrite, pyrrhotite and pentlandite (Campbell and Ethier 1984; Merkle and von Gruenewaldt 1986). Other metals that correlate strongly with sulphide sulphur include copper and zinc. Copper is most likely

contained in chalcopyrite. Gold concentrations correlate with cobalt, arsenic, and nickel in the QAP dykes and rhyolite, indicating gold is potentially associated with cobaltite (Uglow and Osborne 1926).

Bismuth concentration correlations indicate bismuth occurs in association with 2 element groupings. An evaluation of cobalt and bismuth mineralization in Marcoux et al (1996) suggested that bismuth was associated with several phases surrounding a massive sulphide deposit: native bismuth, bismuth associated with base metal sulphides, and bismuth associated with antimony and/or silver. Similar phases are evident in the NICO deposit. In the QAP dykes and the “general waste” samples in the resource block model dataset, bismuth concentrations correlate with Co-Ni-As, indicating an association with the base metal sulphides. In most other lithologies, including black rock schist, feldspar porphyry, wacke and rhyolite, bismuth occurs in association with selenium and antimony, and to a lesser extent, silver.

Bismuth selenide is commonly associated with bismuth ore deposits. Solid phase selenium concentrations at the NICO Project are concentrated mineralized rock. Although selenium minerals have not been identified in exploration stage mineralogical analysis, the correlation between selenium and bismuth suggests an association with bismuth mineralization. Marcoux et al (1996) discussed the variations in selenium throughout bismuth mineral phases and attributed low selenium concentrations in the base metal minerals to the substitution of selenium by tellurium. Tellurium concentrations were only recorded in select samples in the resource block model dataset, and were below detection limits in most.

### 3.I-I.3.2.2 Metal Leaching Potential

According to the results of geochemical characterization, several metals occurred at concentrations in excess of the site-specific water quality objectives in laboratory and field scale leach tests, including the following:

- aluminum, arsenic, iron, and copper (Mine Rock); and
- aluminum, arsenic, cadmium, cobalt, copper, iron, molybdenum, antimony, selenium, uranium, and zinc (sub-economic ore and ore).

Figures Figure 3.I-I-5 through 3.I-I-11 compare the results of laboratory-scale and field scale geochemical tests to solid phase concentrations of select metals. Laboratory-scale and field scale leach test results represent the potential range of potential geochemical conditions that could be realized during operations and closure at the NICO Project, including rapid flushing of solid phase samples that could be realized during precipitation events (i.e., shake flask extraction and synthetic precipitation leaching procedure leachates), metal release in oxidizing conditions (analysis of NAG leachates), and longer-term metal leaching trends in laboratory (kinetic tests) and site conditions (field cells). In the context of identifying preliminary Mine Rock criteria, leachate concentrations are compared to the site-specific water quality objectives, MMER, and background metal concentrations in the Grid Ponds, Nico Lake, and Peanut Lake (where applicable).

As presented in Figure 3.I-I-5, a reasonable correlation exists between solid phase concentrations of arsenic and arsenic concentrations in geochemical test leachates. Many samples reported arsenic leachate concentrations in excess of the reference criteria. Most samples leached arsenic at concentrations in excess of background concentrations in Peanut and Nico lakes. Background concentrations of arsenic are elevated in the Grid Pond basin, which receives drainage from the NICO ore body.

The results of geochemical leach testing suggest that it may not be possible to meet the site specific water quality objective for arsenic (0.05 milligrams per Litre [mg/L]) based on operational Mine Rock management

alone; even background concentrations of arsenic in Nico Lake exceed the reference criteria. Samples containing even low solid phase concentrations of arsenic leach concentrations in excess of Nico and Peanut lakes concentrations. Most samples containing less than 1000 ppm arsenic do not leach arsenic concentrations in excess of the existing concentrations in the Grid Ponds or the MMER average monthly criterion of 0.5 mg/L.

Selenium concentrations in geochemical test leachates correlate reasonably with solid phase concentrations of both selenium (Figure 3.I-I-6) and bismuth (Figure 3.I-I-7). It should be noted that the detection limit concentration for short-term laboratory leach tests and humidity cell tests was 0.005 mg/L. As such, selenium was not detected in geochemical test leachates from these samples, which were generally collected outside the mineralized zones. Selenium is not detected in the Grid Ponds, Nico Lake, or Peanut Lake. Furthermore, the solid phase selenium dataset is limited in size in comparison to the bismuth dataset for the NICO Project. Selenium leachate concentrations correlate well with bismuth, therefore it is proposed that bismuth concentrations be used to distinguish rock with a selenium leaching potential. The selenium leachability dataset is somewhat limited by the fact that many geochemical test leachates were analyzed with a selenium detection limit of 0.005 mg/L. Based on the existing dataset, a solid phase concentration of 50 ppm bismuth would be required to distinguish rock with a low selenium leaching potential.

The correlation between solid phase concentrations and metal leachability is not as well defined for the other metals of concern, including cobalt, copper, nickel and zinc (Figure 3.I-I-8 through 3.I-I-11). This result indicates that the rate metal release is not linear with respect to solid phase concentrations; and metal solubility could be affected by secondary processes controlled by the conditions in which the geochemical tests were conducted. Similar to arsenic, background concentrations of cobalt, copper, and zinc are elevated in the Grid Pond basin indicating that these metals are capable of mobilizing.

### 3.I-I.4 GEOCHEMICAL CRITERIA FOR MINE ROCK MANAGEMENT

Geochemical criteria for Mine Rock management were defined based on the evaluation of the results of geochemical characterization and the data in the resource block model dataset:

- **Acid generation potential:** Rock containing greater than 0.3% sulphide sulphur has potential for acid generation based on the results of net acid generation testing and humidity cell testing.
- **Metal leaching potential:**
  - **Arsenic:** Rock containing greater than 1000 ppm arsenic report arsenic leachate concentrations greater than the MMER average monthly criterion (0.5 mg/L) and background concentrations in the Grid Ponds.
  - **Selenium:** Solid phase selenium concentrations correlate well with solid phase bismuth concentrations. The results of leach testing demonstrate that rock samples containing greater than 50 ppm bismuth leach selenium at concentrations greater than the site specific water quality criterion of 0.005 mg/L selenium.

The proposed geochemical criteria for Mine Rock management are as follows:

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Classification	Criteria	Description
Cover Construction Material	Glacial till / sand	Cover construction material with a low potential for acid generation and metal leaching, and the required grain size characteristics to meet the objectives of the closure cover.
Type 1	< 0.3 % sulphide sulphur < 50 ppm bismuth low arsenic leaching potential	Rock with a low potential for acid generation and metal leaching to be used for construction of surge pond dams, seepage collection pond dams, roads, rock pads and lay down areas.
Type 2	< 0.3% sulphide sulphur < 1000 ppm arsenic	Rock with a low potential for acid generation, to be used for construction of perimeter dykes within the CDF.
Type 3	> 0.3% sulphide sulphur > 50 ppm bismuth > 1000 ppm arsenic	Potentially acid generating and metal leaching rock, to be contained within the CDF. For the purposes of preliminary planning, Type 3 rock should be placed with a minimum 20m offset from the exterior of the perimeter embankments of the CDF.
Sub-economic Mine Rock	Classified according to Fortune's grade control cut-offs	Sub-economic Mine Rock will be placed in segregated stockpiles located only within the areas of the pile that will be covered, at a suitable distance offset from the exterior slopes of the facility.

The samples in the geochemical characterization dataset were categorized according to the proposed Mine Rock classification criteria. Attachment 3.I-1b presents the range of results of short-term leach tests (including synthetic leachate precipitation procedure and shake flask extraction), net acid generation test leachates, humidity cell test leachates and field cell leachates for samples in each Mine Rock management category. The results are compared to the site-specific water quality objectives for the NICO Project:

- **Type 1:** Type 1 Mine Rock will be used to construct general site infrastructure. Concentrations of aluminum, iron, arsenic, cobalt, copper, lead, and zinc occasionally exceeded the site-specific water quality objectives in short-term leach tests. The long-term metal leaching potential of Type 1 Mine Rock was much lower. Arsenic and selenium rarely exceeded the site-specific water quality objectives in longer-term humidity cell test leachates from Type 1 Mine Rock. Acidic leachate pH values were not measured in any Type 1 Mine Rock leach tests.
- **Type 2:** Many parameters occurred at concentrations in excess of the site-specific water quality objectives in Type 2 Mine Rock, which will be used for construction of the perimeter embankments of the CDF, including: iron, aluminum, arsenic, cobalt, copper, lead, and zinc. The short-term metal leaching potential of Type 2 Mine Rock is greater than the long-term metal leaching potential: humidity cell tests and field tests of Type 2 Mine Rock reported occasional elevated concentrations of aluminum, arsenic, antimony, selenium and uranium. Leachate pH values were greater than 6 in all leach tests except one long-term humidity cell test of siltstone.
- **Type 3 and sub-economic mineralized Mine Rock and ore:** Type 3 Mine Rock and sub-economic mineralized Mine Rock/ore will be contained within the perimeter embankment of the CDF. Type 3 Mine Rock and sub-economic mineralized Mine Rock / ore has potential for metal leaching and acid generation according to the results of short-term leach tests, humidity cell tests and field tests.

- **Construction cover material:** Samples collected from various borrow sites at the NICO Project generally had low concentrations of key metals. All construction cover materials will undergo geochemical testing prior to ensure that the cover materials meet the closure objectives for the Project prior to construction of the closure cover.

The Mine Rock management criteria will limit the potential for acid generation and metal leaching from major site infrastructure. The comparison of the results of geochemical leach testing to the site specific water quality criteria indicates that the Mine Rock classification criteria are suitable for the classification of acid generation potential and metal leaching potential in most samples in the range of conditions that could be encountered during construction, operations and closure. However, as presented in Attachment 3.I-1b, some samples may leach metals at concentrations greater than the site specific water quality objectives. The water management plan (Appendix 3.III of the DAR) accounts for the collection of contact water (i.e., seepage and runoff) from the main site facilities during construction and operations. Mine Rock and contact water quality samples will be collected during operations to ensure that the material used for the construction of roads, rock pads, seepage collection dams, and surge pond dams meets the objectives of the MRMP. The Mine Rock classification criteria and closure plan may be updated during operations based on the results of site water quality monitoring.

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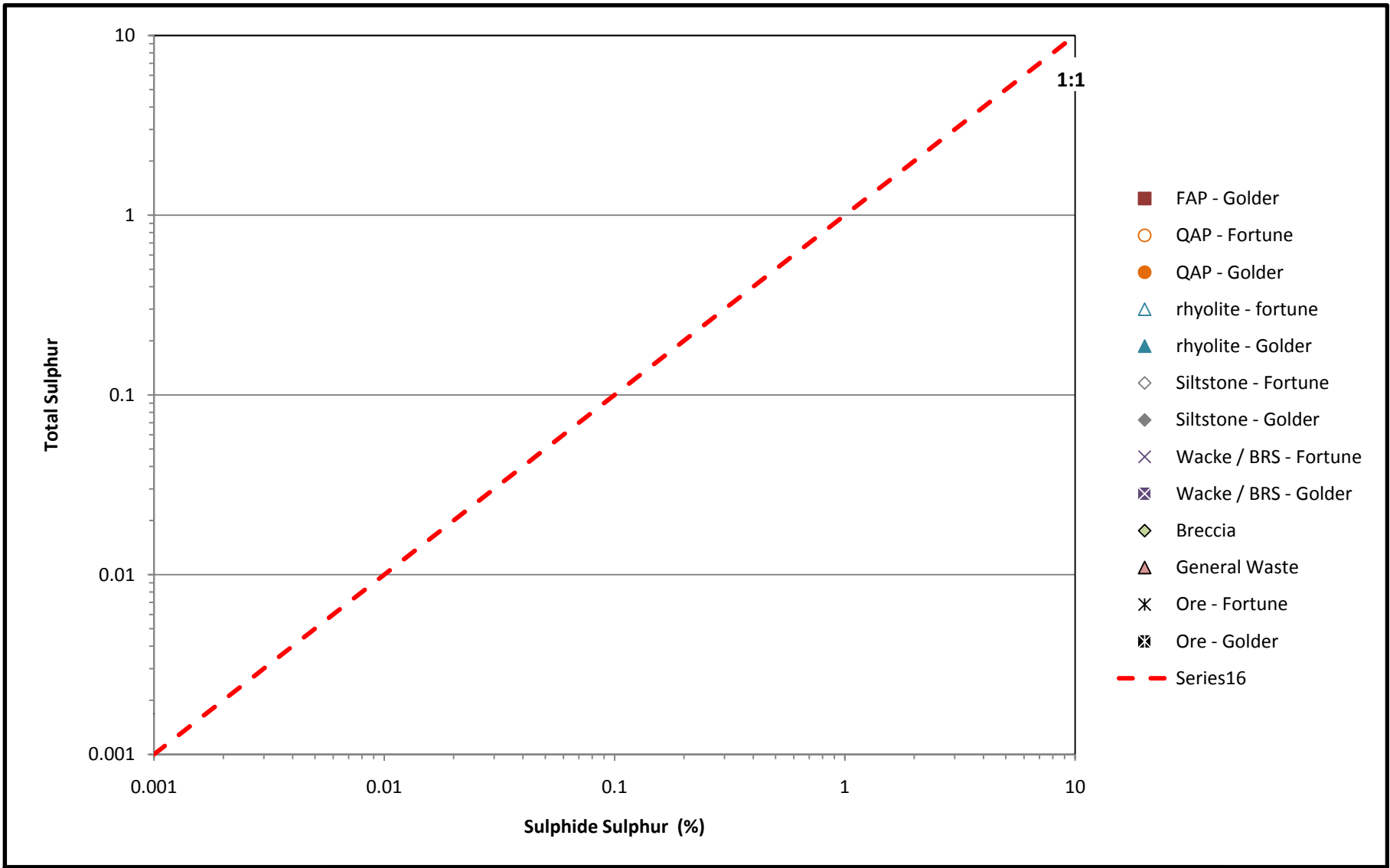
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## FORTUNE MINERALS LIMITED DEVELOPER'S ASSESSMENT REPORT

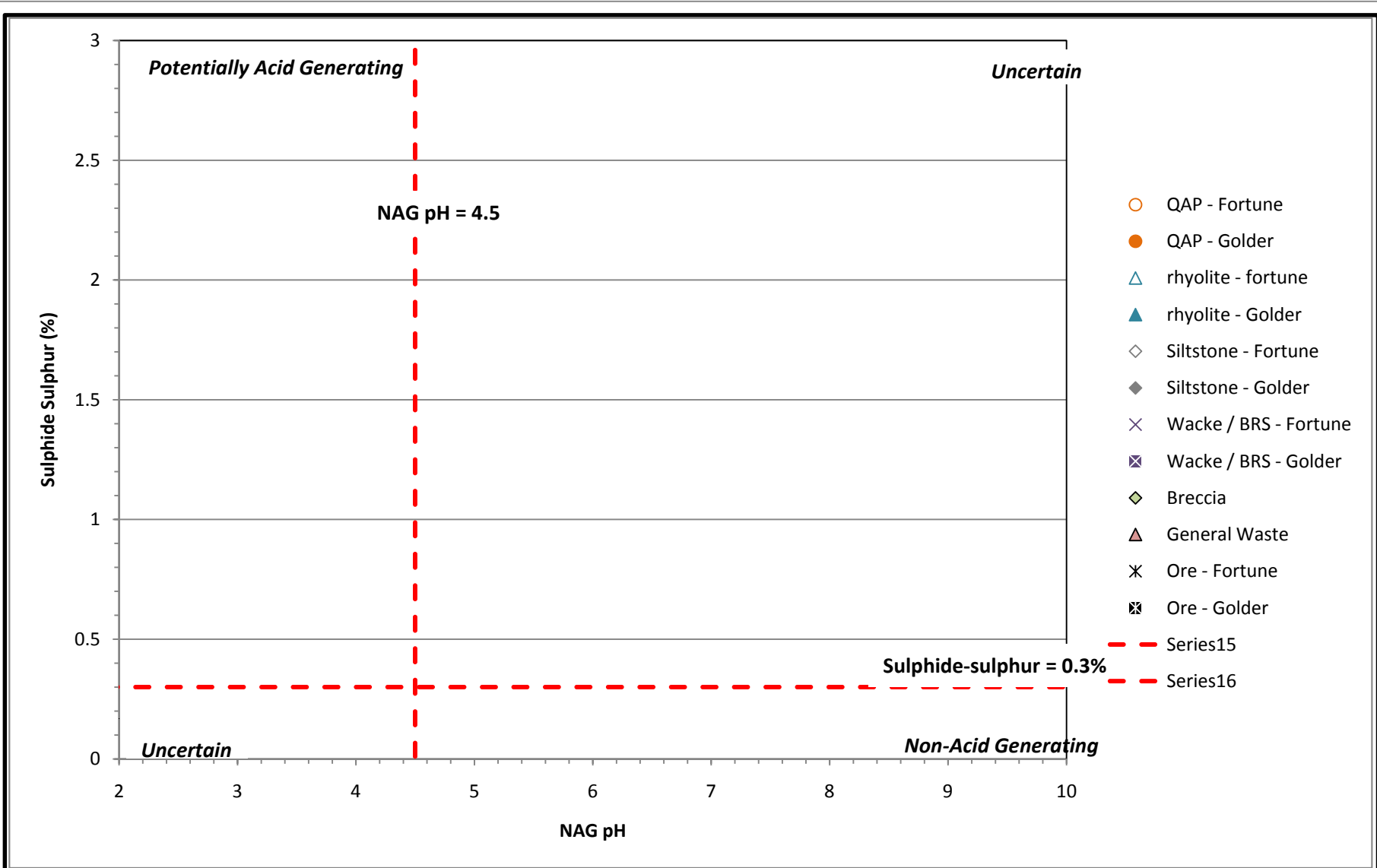
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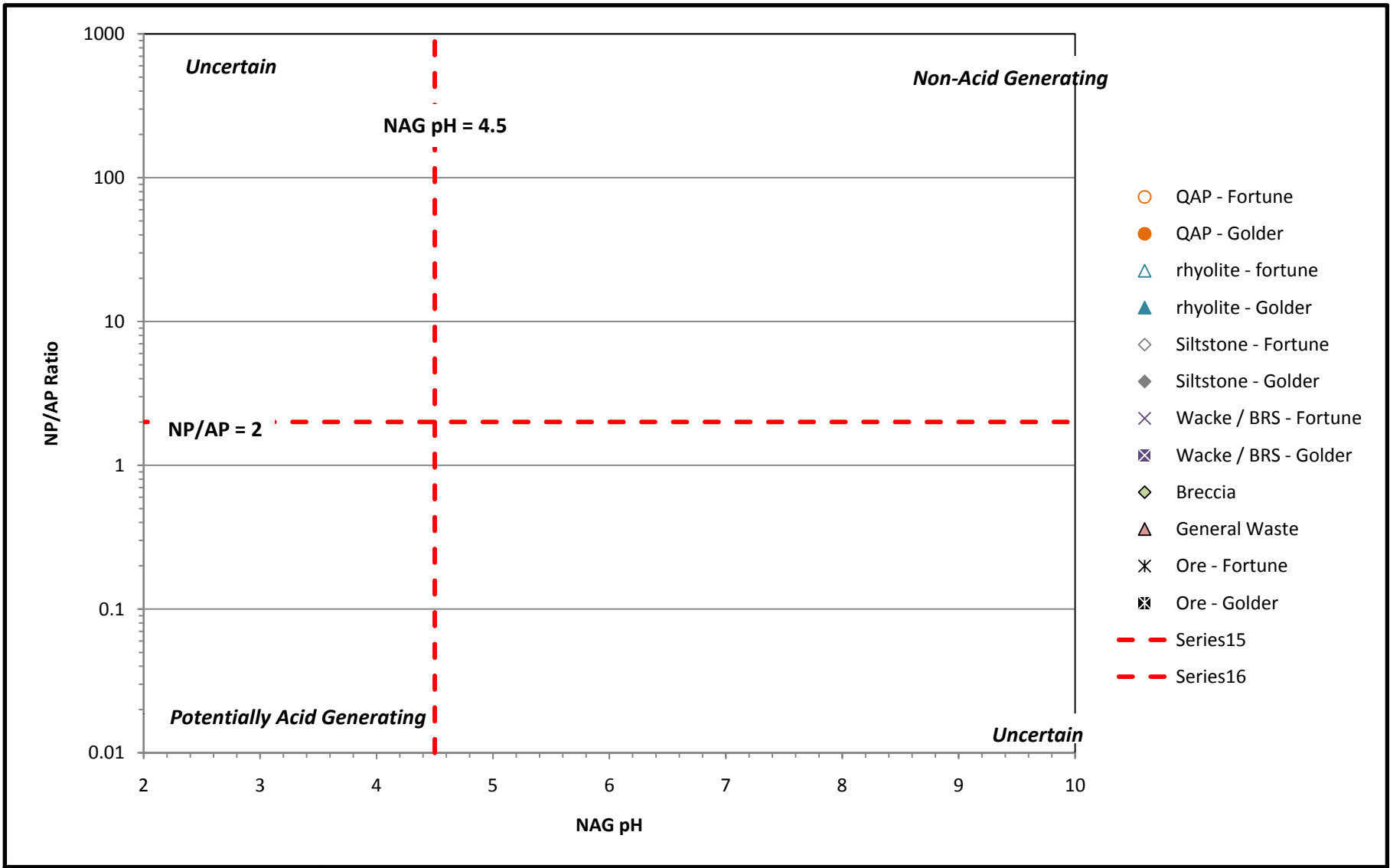
# FIGURES



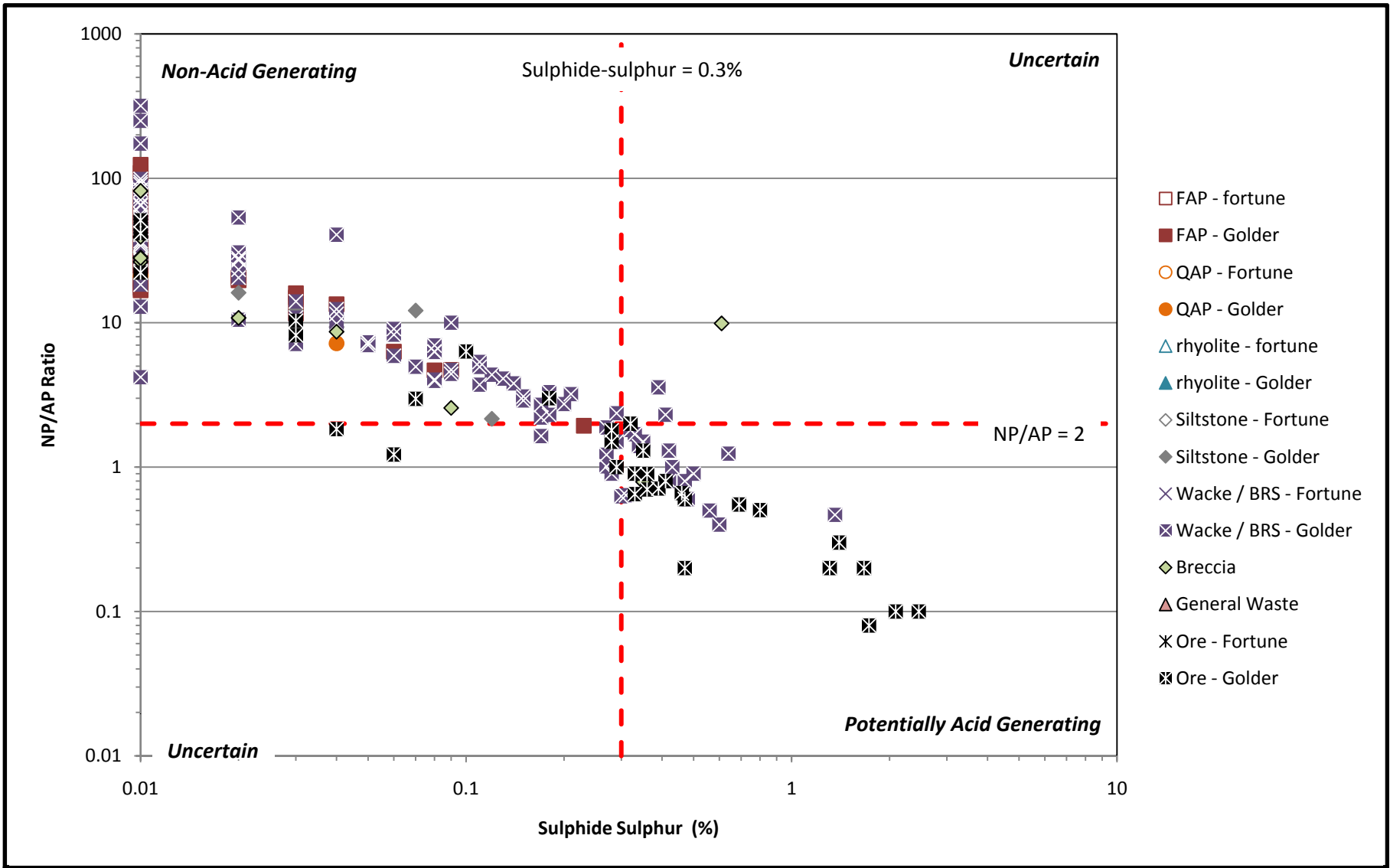
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Project Name		NICO Project		Checked	KD
Client Name		Fortune Minerals Limited		Reviewed	KD
		Project No.	10 1118 0046 5200	FIGURE 3.1.I-1	
		Date	May 14, 2010		



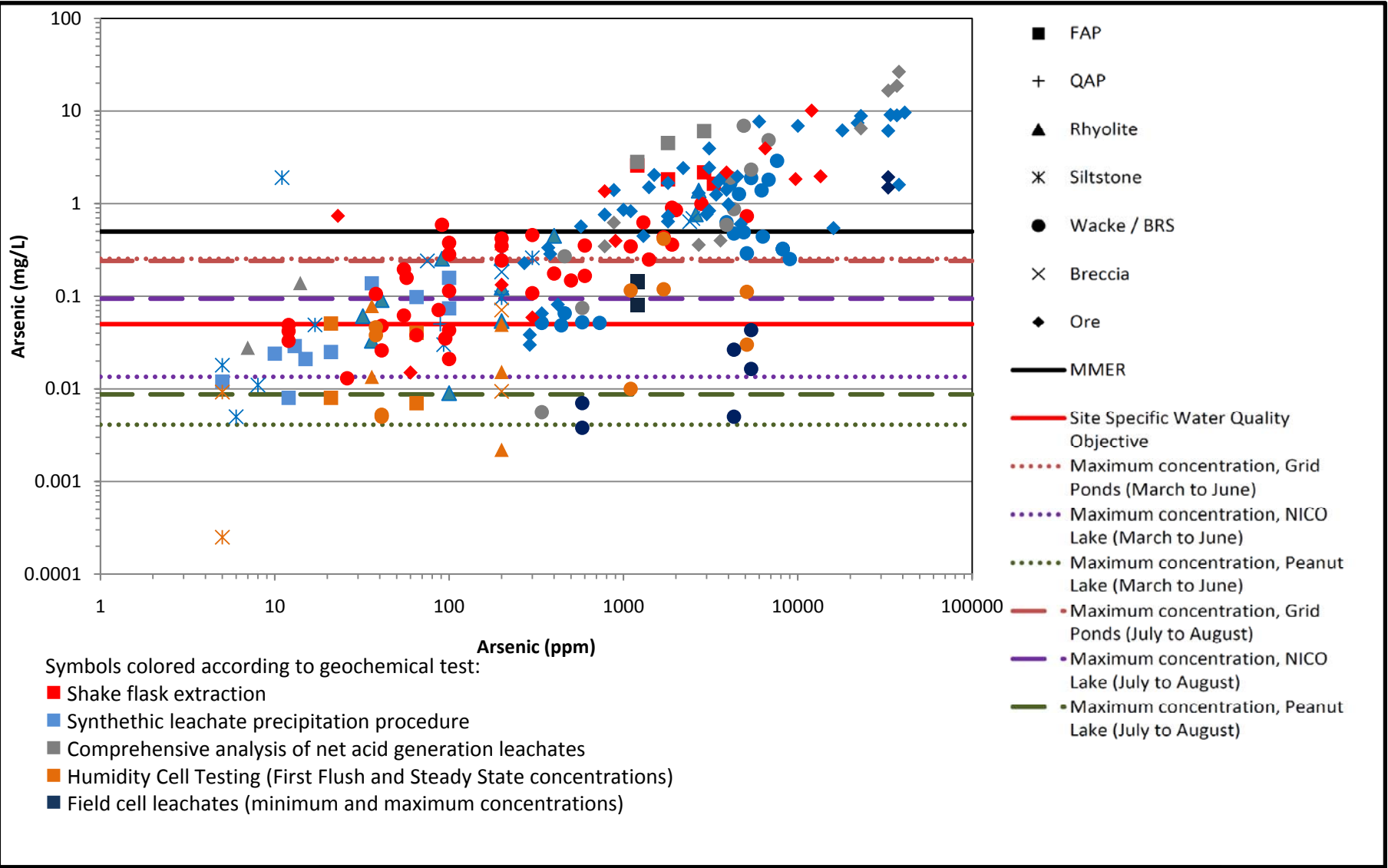
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Project Name		NICO Project		Checked	KD
Client Name		Fortune Minerals Limited		Reviewed	KD
		Project No.	10 1118 0046 5200	FIGURE 3.1.I-2	
		Date	May 14, 2010		



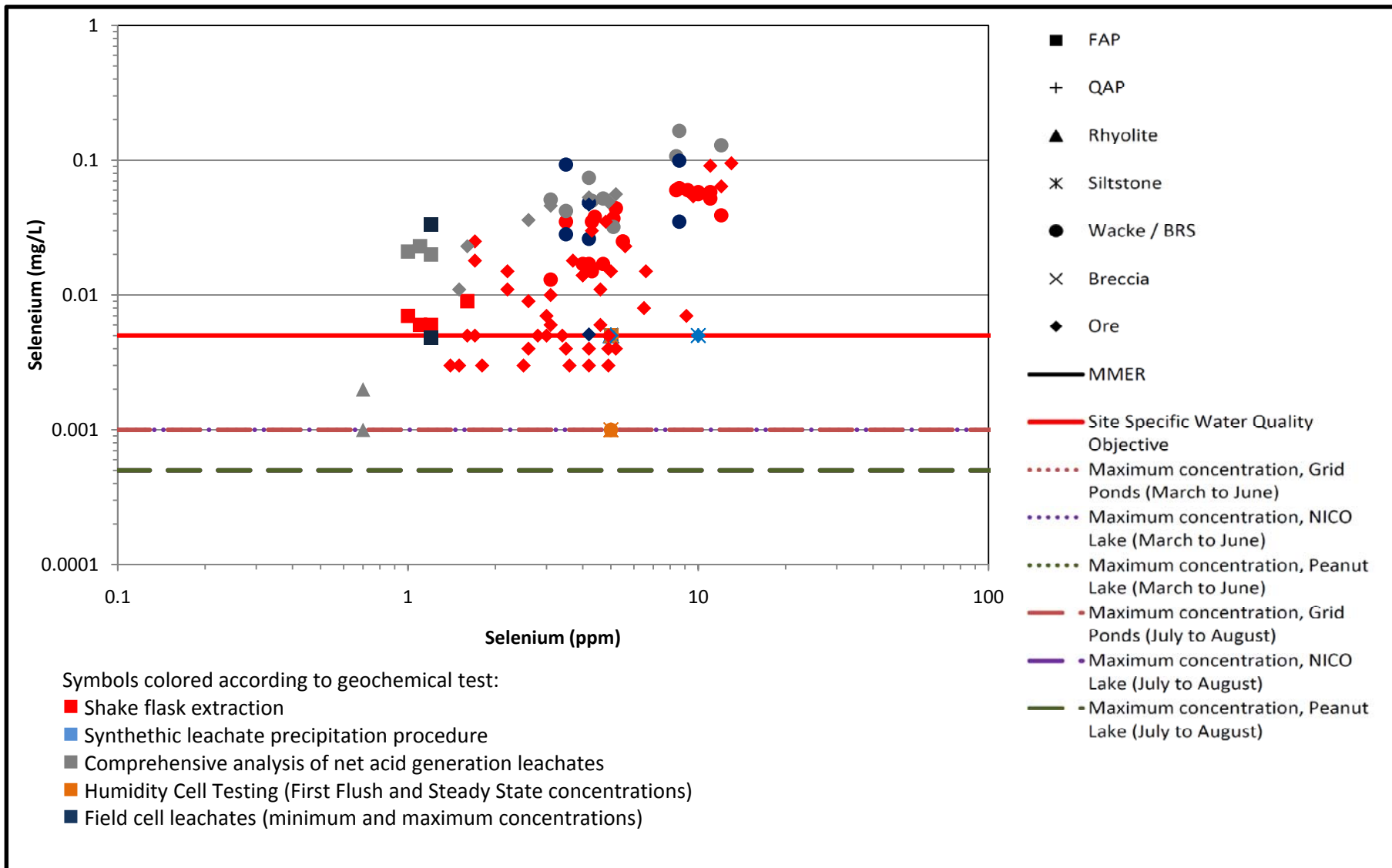
Title		NP/AP Ratio vs. NAG pH		Drawn	KAS
Project Name		NICO Project		Checked	KD
Client Name		Fortune Minerals Limited		Reviewed	KD
		Project No.	10 1118 0046 5200	FIGURE 3.1.I-3	
		Date	May 14, 2010		



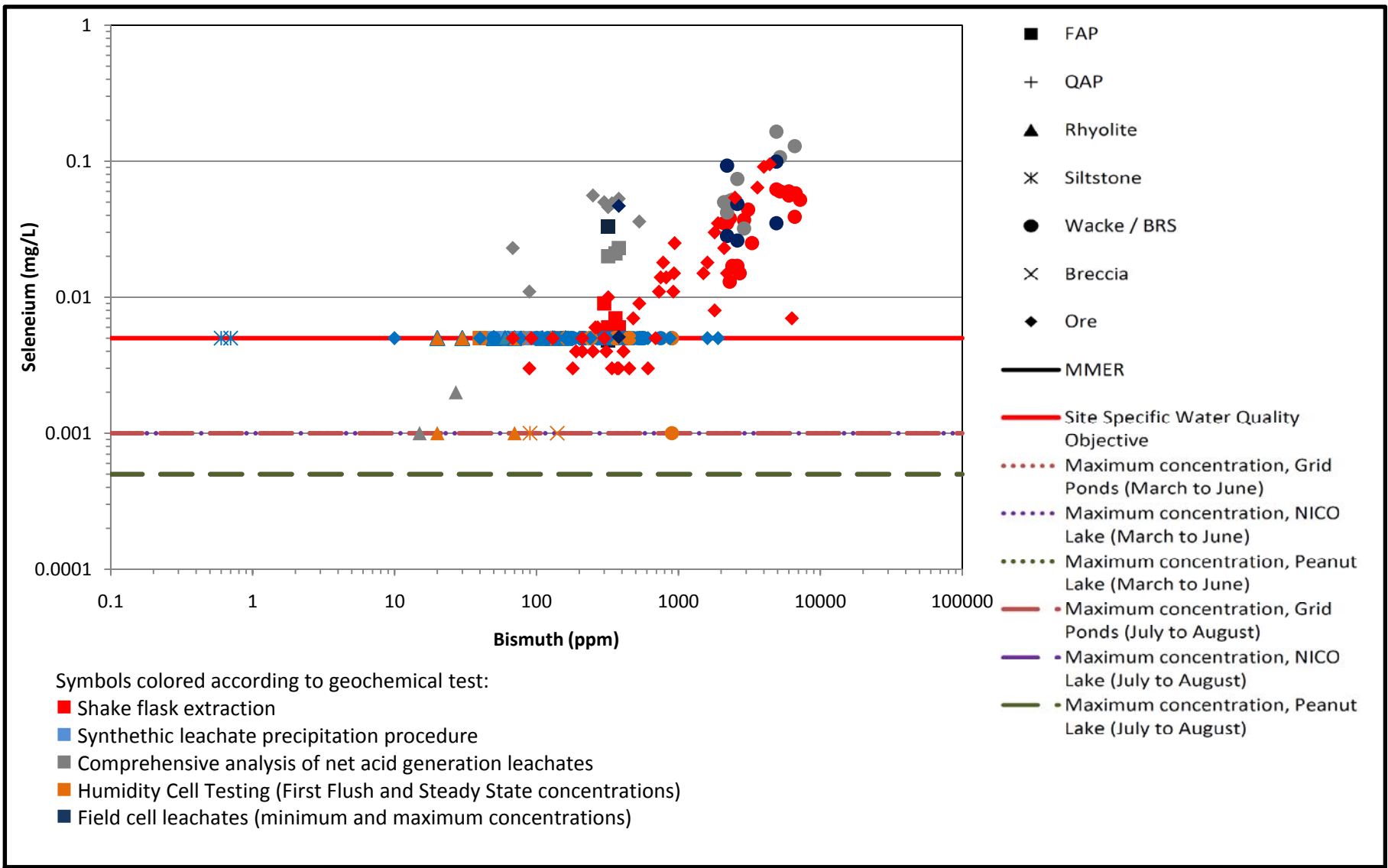
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Project Name		NICO Project		Checked	KD
Client Name		Fortune Minerals Limited		Reviewed	KD
		Project No.	10 1118 0046 5200	FIGURE 3.I.1-4	
		Date	May 14, 2010		



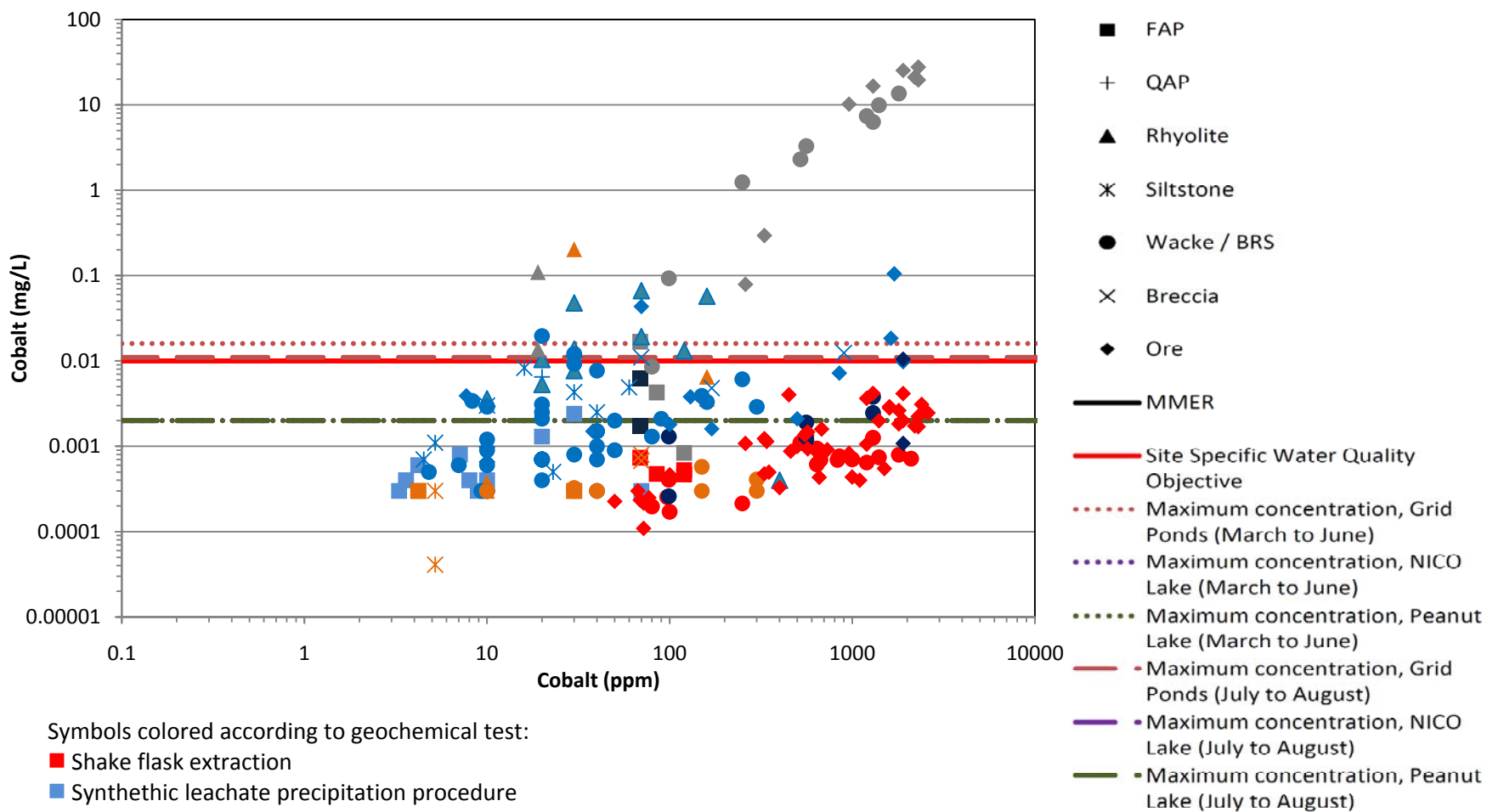
Title		Arsenic (mg/L) vs. Arsenic (ppm)		Drawn	KAS	
Project Name	NICO Project	Project No.	10 1118 0046 5200	Checked	KD	
Client Name	Fortune Minerals Limited	Date	May 6, 2011	Reviewed	KD	
					FIGURE 3.1.I-5	



Title		Selenium (mg/L) vs. Selenium (ppm)		Drawn	KAS
Project Name		NICO Project		Checked	KD
Client Name		Fortune Minerals Limited		Reviewed	KD
		Project No.	10 1118 0046 5200		
		Date	May 6, 2011		
				FIGURE 3.I.I-6	



Title		Selenium (mg/L) vs. Bismuth (ppm)		Drawn	KAS	
Project Name	NICO Project	Project No.	10 1118 0046 5200	Checked	KD	
Client Name	Fortune Minerals Limited	Date	May 6, 2011	Reviewed	KD	
					FIGURE 3.1.I-7	

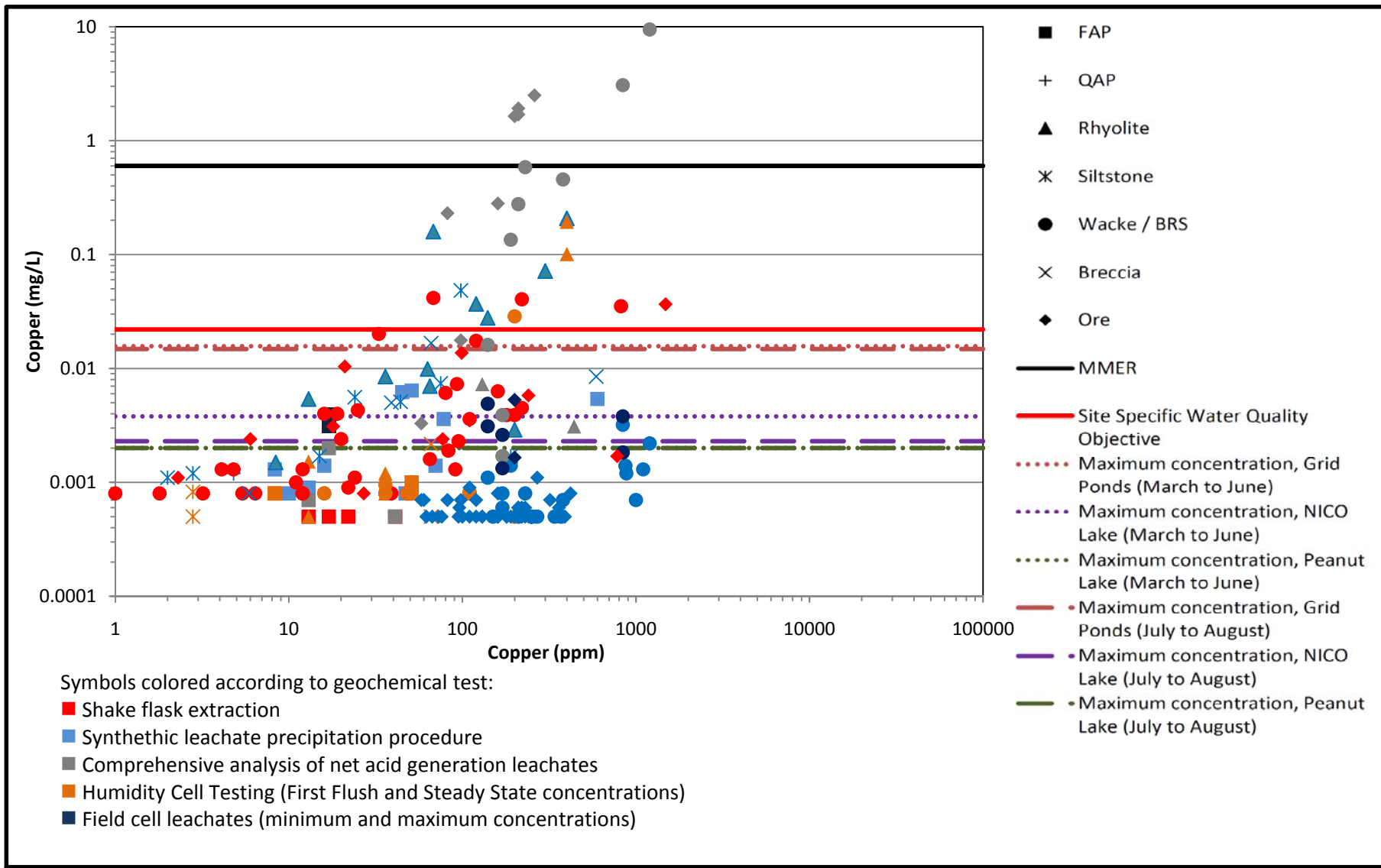


Symbols colored according to geochemical test:

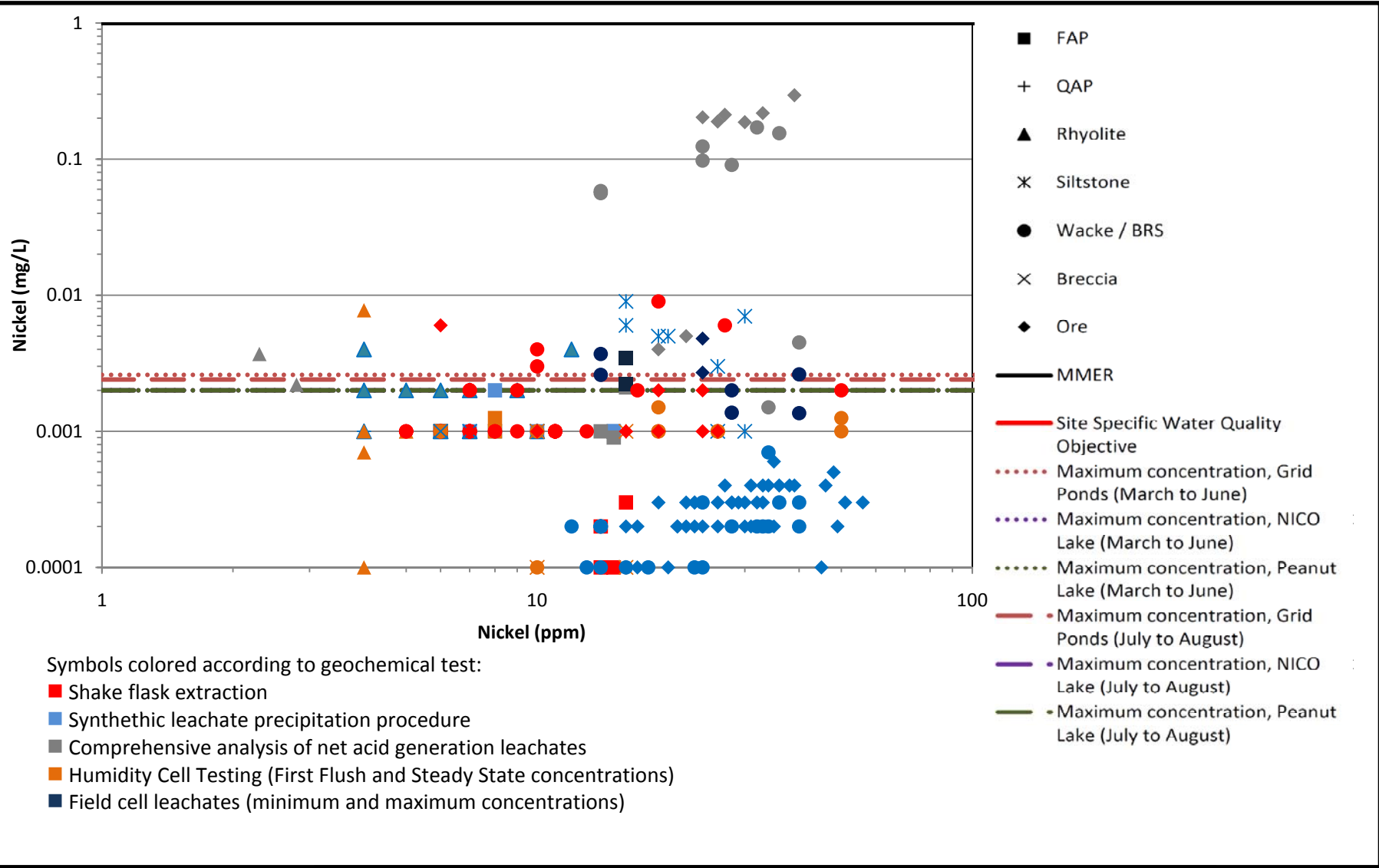
- Shake flask extraction
- Synthetic leachate precipitation procedure
- Comprehensive analysis of net acid generation leachates
- Humidity Cell Testing (First Flush and Steady State concentrations)
- Field cell leachates (minimum and maximum concentrations)



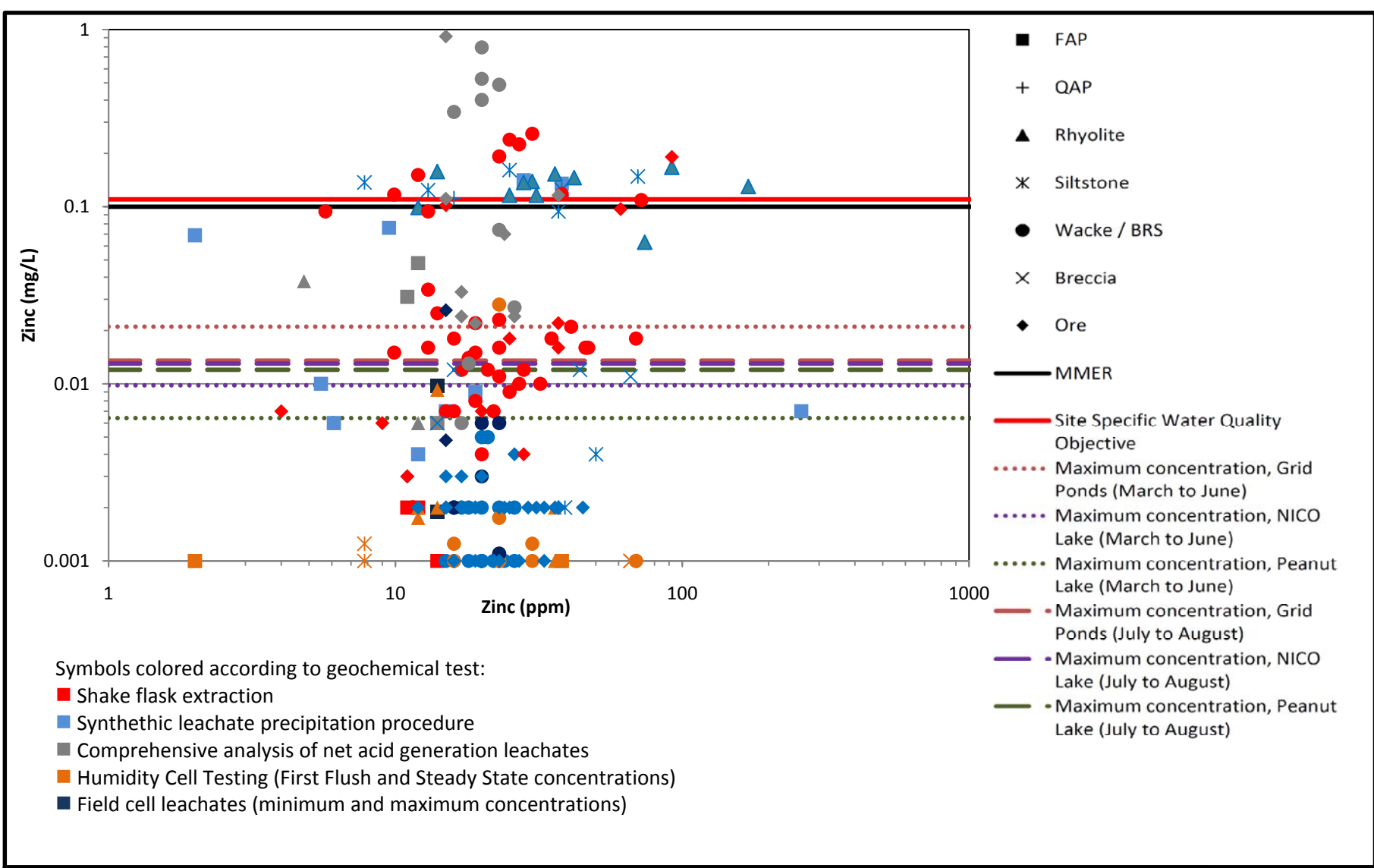
Title		Cobalt (mg/L) vs. Cobalt (ppm)		Drawn	KAS
Project Name	NICO Project	Project No.	10 1118 0046 5200	Checked	KD
Client Name	Fortune Minerals Limited	Date	May 6, 2011	Reviewed	KD
				FIGURE 3.1.I-8	



Title		Copper (mg/L) vs. Copper (ppm)		Drawn	KAS
Project Name		NICO Project		Checked	KD
Client Name		Fortune Minerals Limited		Reviewed	KD
		Project No.	10 1118 0046 5200		
		Date	May 6, 2011		
FIGURE 3.I.I-9					



Title		Nickel (mg/L) vs. Nickel (ppm)		Drawn	KAS	
Project Name	NICO Project	Project No.	10 1118 0046 5200	Checked	KD	
Client Name	Fortune Minerals Limited	Date	May 6, 2011	Reviewed	KD	
					FIGURE 3.1.I-10	



Title		Zinc (mg/L) vs. Zinc (ppm)		Drawn	KAS	
Project Name		NICO Project	Project No.	10 1118 0046 5200	Checked	KD
Client Name		Fortune Minerals Limited	Date	May 6, 2011	Reviewed	KD
FIGURE 3.I.I-11						

# Attachment 3.I-Ia

## Correlation Appendices

	Ag	Al	As	Ba	Be	B	Bi	Ca	Cd	Co	Cr	Cu	Fe	K	Li	Mg	Mn	Mo	Na	Ni	Pb	Sb	Se	Sn	Sr	Ti	Tl	U	V	W	Y	Zn	Au	Te	S_%	SO4-S_%	IULPHIDE-	TC_%	CO3_%		
Ag	1																																								
Al	-0.4868391	1																																							
As	-0.2072861	0.346845	1																																						
Ba	-0.3476832	0.791815	0.135975	1																																					
Be	-0.1263503	-0.05564	-0.47323	-0.31704	1																																				
B						1																																			
Bi	0.3617511	-0.71538	-0.03593	-0.78853	0.272142	---	1																																		
Ca	0.1377541	-0.49635	-0.24379	-0.18854	-0.04825	---	0.02466	1																																	
Cd	0.5548265	0.180716	-0.25019	0.288442	-0.00584	---	-0.40193	-0.18299	1																																
Co	0.1053079	0.039408	0.688415	-0.26193	-0.30465	---	0.210103	-0.1793	-0.17176	1																															
Cr	-0.4785405	0.1313	-0.23398	0.413543	-0.24783	---	-0.48149	-0.16989	0.477067	-0.21048	1																														
Cu	0.1162704	-0.01919	0.571398	-0.32411	-0.22499	---	0.233585	-0.1066	-0.17816	0.985427	-0.21013	1																													
Fe	0.1920718	-0.21029	0.101525	-0.2312	0.061302	---	0.38058	-0.12974	0.027176	0.196538	-0.07897	0.204545	1																												
K	-0.5838991	0.820525	0.287942	0.623436	0.077354	---	-0.49133	-0.38134	-0.13488	0.181346	0.031598	0.16336	-0.22856	1																											
Li	0.2324771	-0.11529	-0.14859	-0.19939	0.221029	---	0.273431	-0.16426	0.279364	-0.37008	-0.36324	-0.40758	-0.06466	-0.40227	1																										
Mg	0.3328959	-0.60767	-0.22187	-0.5748	0.378958	---	0.56705	0.339347	-0.15122	0.076128	-0.19468	0.151643	0.717633	-0.46087	-0.13983	1																									
Mn	-0.0134189	-0.41313	-0.21989	-0.42406	0.434518	---	0.161642	0.647796	-0.21185	-0.22188	-0.24023	-0.15437	0.035649	-0.39947	0.07805	0.57672	1																								
Mo	0.275157	-0.20692	0.469483	-0.48091	-0.19175	---	0.345525	0.100011	-0.2123	0.917747	-0.39736	0.948385	0.143809	-0.01962	-0.25304	0.229232	0.016756	1																							
Na	-0.6459999	0.619586	0.070868	0.464678	0.13367	---	-0.46269	-0.32702	-0.20847	-0.24483	0.111079	-0.28829	-0.69812	0.647364	-0.08021	-0.73397	-0.25463	-0.40512	1																						
Ni	-0.3574946	0.256838	0.035803	0.323146	0.177125	---	0.056889	-0.30961	-0.07565	-0.04345	0.184431	-0.05038	0.587004	0.413404	-0.34547	0.23296	-0.34299	-0.25902	0.004351	1																					
Pb	0.4607716	-0.12067	-0.34025	-0.04177	0.206911	---	-0.11592	0.398387	0.607115	-0.21187	-0.13906	-0.17034	-0.30438	-0.25848	0.463407	-0.10608	0.175792	0.006785	-0.17622	-0.42091	1																				
Sb	0.1219353	-0.26235	-0.00525	-0.02422	-0.18525	---	-0.24204	0.906531	-0.02534	-0.02099	-0.06111	0.017052	-0.31595	-0.23421	-0.2206	0.105553	0.584283	0.181778	-0.1761	-0.46727	0.456743	1																			
Se	---	-0.44258	0.037553	-0.64061	0.382035	---	0.777745	0.152383	-0.52606	0.167054	-0.81008	0.190501	-0.02127	-0.14774	0.360566	0.229522	0.198303	0.365248	-0.08646	-0.127	0.129034	-0.03547	1																		
Sn	0.0785516	-0.25184	0.280308	-0.26711	-0.39066	---	0.29465	-0.13837	-0.21738	0.513842	0.065645	0.516957	0.74434	-0.15716	-0.43378	0.441348	-0.24009	0.419407	-0.54473	0.395429	-0.56705	-0.25342	-0.10294	1																	
Sr	-0.1623507	0.401778	-0.24859	0.726381	0.04244	---	-0.41984	0.19341	0.124014	-0.52015	0.122152	-0.5267	-0.34908	0.444033	-0.0563	-0.38061	-0.22035	-0.54928	0.418001	0.331535	0.283988	0.162506	-0.14336	-0.51872	1																
Ti	-0.2484501	0.093452	-0.09936	0.408621	-0.1371	---	0.031483	-0.29511	-0.0433	-0.24775	0.465612	-0.2752	0.439411	0.183676	-0.29058	0.115741	-0.41706	-0.46284	-0.02136	0.819755	-0.53658	-0.4708	-0.32003	0.383784	0.346003	1															
Tl	0.0561479	-0.17689	0.12887	0.167475	-0.37719	---	0.125562	0.116856	-0.08179	-0.06706	0.19271	-0.09985	0.736229	-0.22634	-0.23257	0.444099	-0.06203	-0.17145	-0.51833	0.587293	-0.41054	-0.05632	-0.27898	0.645363	0.051199	0.71916	1														
U	0.11792	0.021187	0.208951	-0.15227	-0.10112	---	-0.2179	0.446736	0.003479	0.469307	-0.21548	0.513668	-0.49512	0.082152	-0.21515	-0.20556	0.207837	0.61207	0.069123	-0.58194	0.473666	0.661844	0.130571	-0.23056	-0.08885	-0.79037	-0.5786	1													
V	-0.0708578	-0.11012	-0.1397	0.25324	-0.10538	---	0.193283	-0.1568	-0.04785	-0.34203	0.309176	-0.37363	0.572375	-0.07457	-0.10102	0.313437	-0.22188	-0.48289	-0.23799	0.729689	-0.4564	-0.38911	-0.20515	0.39161	0.260127	0.938981	0.83269	-0.87169	1												
W	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Y	-0.4662132	0.270478	0.117765	-0.02307	0.617918	---	-0.07709	-0.05386	-0.17123	-0.23326	-0.20781	-0.25806	-0.26581	0.20744	0.220442	-0.05557	0.493227	-0.27347	0.521444	-0.06569	0.027676	0.053025	0.185261	-0.57911	0.038816	-0.31135	-0.41648	0.072962	-0.29971	---	---	---	---	---	---	---	---				
Zn	0.4702628	0.000152	-0.19187	-0.14663	0.451471	---	0.130742	-0.10203	0.64962	-0.08221	-0.26075	-0.07227	0.021382	-0.17469	0.673417	0.033577	0.047487	0.032453	-0.2231	-0.17816	0.791804	-0.06052	0.250451	-0.43964	0.050562	-0.39527	-0.37815	-0.29385	---	---	0.176434	1									
Au	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Te	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
S_%	0.1481913	-0.37454	0.131689	-0.23859	-0.23865	---	0.062718	0.850274	-0.25644	0.344229	-0.24112	0.406411	-0.12075	-0.20889	-0.34459	0.25599	0.465834	0.562129	-0.36012	-0.35644	0.290687	0.865224	0.199016	0.064005	-0.02607	-0.42996	0.015956	0.71906	-0.37592	---	-0.16701	-0.15099	---	---	---	---	---				
SO4-S_%	0.219022	-0.4943	0.021691	-0.19565	-0.31901	---	-0.11704	0.884155	-0.14409	0.246098	-0.24545	0.316223	-0.11289	-0.26309	-0.42558	0.303888	0.480095	0.489162	-0.44332	-0.37529	0.3133	0.896235	---	0.075405	0.02626	-0.38033	0.120338	0.705741	-0.32504	---	-0.26604	-0.18304	---	---	0.991118	1					
IULPHIDE-	0.1316813	-0.40045	0.18359	-0.17863	-0.35444	---	-0.14904	0.82694	-0.18353	0.362794	-0.25045	0.418099	-0.11168	-0.18318	-0.48107	0.248206	0.437585	0.561239	-0.38429	-0.33957	0.259387	0.885035	---	0.113741	-0.01891	-0.40099	0.102503	0.765137	-0.37768	---	-0.20295	-0.21267	---	---	0.998303	0.982747	1				
TC_%	0.1371377	-0.55156	-0.24406	-0.10388	-0.12149	---	-0.19513	0.9957	-0.10706	-0.17913	-0.16648	-0.10833	-0.19492	-0.36399	-0.22905	0.305993	0.645722	0.081681	-0.32664	-0.35232	0.420731	0.939981	---	-0.17108	0.241169	-0.31052	0.143538	0.513032	-0.18932	---	-0.07123	-0.12035	---	---	0.869851	0.903501	0.849016	1			
CO3_%	0.126443	-0.53087	-0.23134	-0.08175	-0.12484	---	-0.20521	0.99241	-0.10729	-0.17175	-0.15629	-0.10185	-0.20932	-0.34642	-0.22898	0.290611	0.641329	0.085862	-0.31529	-0.3517	0.423012	0.942028	---	-0.18491	0.253868	-0.30974	0.134922	0.520761	-0.19392	---	-0.06452	-0.11805	---	---	0.874273	0.906266	0.85368	0.99944	1		

Notes:  
  Elements with positive correlation greater than 0.75  
  Elements with negative correlation lower than -0.75



	Ag	Al	As	Ba	Be	B	Bi	Ca	Cd	Co	Cr	Cu	Fe	K	Li	Mg	Mn	Mo	Na	Ni	Pb	Sb	Se	Sn	Sr	Ti	Tl	U	V	W	Y	Zn	Au	Te	S_%	SO4-S_%	SULPHIDE-	TC_%	CO3_%											
Ag	1																																																	
Al		1																																																
As			1																																															
Ba		0.499532		1																																														
Be		0.319265		0.002329	1																																													
B						1																																												
Bi		-0.29891	0.834558	-0.25783	0.053511		1																																											
Ca		0.122942		-0.1163	0.656934		-0.05613	1																																										
Cd		-0.2589		-0.14935	-0.24248		0.420245	-0.2842	1																																									
Co		0.166243	0.864433	0.063254	-0.24033		0.858191	-0.2951	0.503718	1																																								
Cr		-0.59326		-0.23169	-0.74994		0.060592	-0.71426	0.2563	0.160616	1																																							
Cu		-0.32096	-0.28694	-0.31287	-0.45854		0.004286	-0.40108	0.477709	0.002527	0.388666	1																																						
Fe		0.304442		-0.05892	0.887357		0.107815	0.745883	-0.26006	-0.12334	-0.81203	-0.46544	1																																					
K		0.629478		0.698802	0.504944		-0.20341	0.324855	-0.3317	-0.03442	-0.69341	-0.54389	0.560354	1																																				
Li															1																																			
Mg																1																																		
Mn		-0.11341		-0.41332	0.203357		0.159766	0.342536	0.435187	0.3526	-0.07861	0.197779	0.196982	-0.30762		1																																		
Mo		-0.1112		-0.11853	0.058912		0.11331	0.09085	-0.0529	-0.10911	-0.12021	-0.13114	0.192725	-0.00785		0.021715	1																																	
Na		0.756168		0.121649	0.016099		-0.22685	-0.13983	-0.20692	0.047453	-0.21951	-0.04236	-0.06486	0.04447		-0.13026	-0.06435	1																																
Ni		0.314032		-0.11526	0.387379		0.45791	0.338349	-0.1289	0.395469	-0.40116	-0.17887	0.543495	0.21024		0.20686	0.054357	0.198084	1																															
Pb		-0.3435		0.03879	-0.33063		0.204666	-0.20703	0.349278	0.205745	0.274906	0.346089	-0.37109	-0.19503		-0.07862	-0.06897	-0.25162	-0.24951	1																														
Sb																						1																												
Se																							1																											
Sn																								1																										
Sr		0.808748		0.781504	0.334602		-0.18468	0.196704	-0.22215	0.158658	-0.60767	-0.36728	0.334457	0.848563		-0.26188	-0.13137	0.350793	0.227762	-0.11452																														
Ti																								1																										
Tl																									1																									
U																										1																								
V		0.756827		-0.04229	0.32393		-0.18239	0.235409	-0.17822	0.356743	-0.45924	-0.16659	0.417214	0.309211		0.189922	-0.06491	0.625371	0.501585	-0.34211					0.450563																									
W																										1																								
Y																											1																							
Zn		-0.25921		-0.154	-0.24086		0.424579	-0.27939	0.997086	0.48256	0.24805	0.487322	-0.25672	-0.33419		0.407636	-0.05218	-0.19461	-0.12729	0.359084																														
Au		-0.22494	0.676859	-0.15808	0.001662		0.72941	0.204801	0.032583	0.861932	-0.13236	0.012453	0.164488	-0.06363		0.114876	0.46471	-0.17768	0.527562	0.061869																														
Te																																																		
S_%																																																		
SO4-S_%																																																		
SULPHIDE-																																																		
TC_%																																																		
CO3_%																																																		

Notes:  
  Elements with positive correlation greater than 0.75  
  Elements with negative correlation lower than -0.75

	Ag	Al	As	Ba	Be	B	Bi	Ca	Cd	Co	Cr	Cu	Fe	K	Li	Mg	Mn	Mo	Na	Ni	Pb	Sb	Se	Sn	Sr	Ti	Tl	U	V	W	Y	Zn	Au	Te	S_%	SO4-S_%	IULPHIDE-	TC_%	CO3_%			
Ag	1																																									
Al	-0.00275	1																																								
As	1	1	1																																							
Ba	-0.40324	0.753578	-0.99675	1																																						
Be	-0.00438	0.238415	1	0.280228	1																																					
B						1																																				
Bi	0.997492	0.164698	0.96414	-0.40126	-0.11726		1																																			
Ca	-0.0817	-0.39105	1	-0.48233	-0.24929		-0.18716	1																																		
Cd	-0.0331	-0.66554	1	-0.62816	-0.13928		-0.15837	0.163964	1																																	
Co	0.998238	-0.02855	0.956863	-0.41216	-0.21593		0.850348	0.184952	-0.03346	1																																
Cr	-0.00403	-0.45794	1	-0.27278	-0.43768		-0.12156	0.24328	0.29823	-0.14698	1																															
Cu	0.836912	0.222964	0.587414	-0.32338	-0.12692		0.251868	-0.19656	-0.07846	0.329361	-0.03221	1																														
Fe	-0.03618	-0.71488	1	-0.74695	-0.1539		-0.2921	0.346672	0.91645	0.001358	0.305179	-0.1432	1																													
K	0.056953	0.867047	1	0.811795	0.15998		0.313266	-0.3883	-0.75722	0.159413	-0.42596	0.287943	-0.85834	1																												
Li	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Mg	-0.98998	1	-0.98985	0.97518	1		-0.99071	1	1	-0.98997	1	-0.97424	1																													
Mn	-0.10785	-0.51847	1	-0.59975	-0.12555		-0.28106	0.713406	0.503001	0.004905	0.190162	-0.17729	0.626028	-0.60134	1																											
Mo	0.012765	0.040871	1	0.008315	-0.20003		-0.12086	0.011733	-0.25431	0.230402	-0.00347	0.002507	-0.08747	0.086143	1																											
Na	-0.09311	0.850296	1	0.504644	0.22133		0.023158	-0.34189	-0.43765	-0.27088	-0.25248	0.074021	-0.45835	0.518503	1																											
Ni	0.99806	-0.14724	0.999996	-0.42221	-0.24533		0.998303	0.378862	0.293052	0.999356	0.184386	0.839985	0.510012	-0.33764	1																											
Pb	-0.14995	0.284684	-0.91225	0.256782	0.238431		-0.16587	-0.18158	-0.1891	-0.15789	-0.09043	-0.16041	-0.20718	0.190215	1																											
Sb	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Se	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Sn	0.997406	1	0.997472	-0.99995	1		0.997012	1	1	0.997409	1	0.999906	1	-0.97724	1																											
Sr	-0.18308	0.606611	-0.99851	0.306464	0.144301		-0.1862	0.009974	-0.28031	-0.18179	-0.15537	-0.20299	-0.12319	0.254369	1																											
Ti	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Tl	-0.81415	1	-0.81362	0.764142	1		-0.81721	1	1	-0.81412	1	-0.76142	1																													
U	-0.95504	0.475032	-0.94859	0.894955	-0.56282		-0.95625	-0.05702	0.081975	-0.95526	0.983198	-0.92986	0.305092	0.398285	1																											
V	-0.10444	-0.14476	-0.82018	-0.31873	-0.0896		-0.10865	0.341402	0.38505	-0.10113	0.21502	-0.19334	0.596473	-0.49088	1																											
W	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Y	0.960769	1	0.961023	-0.98017	1		0.959289	1	1	0.960783	1	0.980995	1	-0.91197	1																											
Zn	-0.10268	-0.46556	-0.9173	-0.42694	0.042716		-0.10537	0.253774	0.641476	-0.09696	0.107375	-0.167	0.648323	-0.62583	1																											
Au	0.986029	-0.00866	0.948139	-0.41487	-0.15852		0.4113	0.264712	-0.07857	0.440177	-0.17962	0.23578	-0.04772	0.193285	1																											
Te	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
S_%	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
SO4-S_%	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
IULPHIDE-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
TC_%	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
CO3_%	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	

Notes:  
  Elements with positive correlation greater than 0.75  
  Elements with negative correlation lower than -0.75

	Ag	Al	As	Ba	Be	B	Bi	Ca	Cd	Co	Cr	Cu	Fe	K	Li	Mg	Mn	Mo	Na	Ni	Pb	Sb	Se	Sn	Sr	Ti	Tl	U	V	W	Y	Zn	Au	Te	S_%	SO4-S_%	IULPHIDE-	TC_%	CO3_%	
Ag	0.000665	?																																						
Al	-0.04602	0.03367	?																																					
As	0.135444	0.301865	-0.20369	?																																				
Ba	0.042462	-0.07561	-0.10384	-0.00168	?																																			
Be	0.606591	-0.63891	-0.06991	-0.88085	0.932388	?																																		
B	-0.04042	0.04222	0.253326	-0.13609	-0.04656	-0.43104	?																																	
Bi	-0.04783	0.12117	0.03966	-0.17865	0.190181	0.887652	-0.00551	?																																
Ca	0.096936	0.205501	0.002498	0.095471	0.023545	0.185914	-0.06719	0.125965	?																															
Cd	-0.0259	-0.06935	0.700919	-0.3366	0.030332	0.507876	0.320882	-0.02492	0.062583	?																														
Co	0.021501	0.056895	0.024277	0.11236	-0.01304	-0.60561	0.105266	-0.11194	-0.03463	0.031295	?																													
Cr	-0.03231	-0.03224	0.108251	-0.47539	0.124489	-0.26822	0.171637	-0.01271	0.127128	0.346402	0.04027	?																												
Cu	-0.05695	0.196331	0.167488	-0.38149	0.430173	0.933546	0.093161	0.616719	0.149003	0.236357	-0.10523	0.43419	?																											
Fe	-0.03035	0.75021	0.072389	0.177441	-0.15685	-0.78786	0.079088	0.202375	-0.06068	-0.05403	0.083346	-0.08994	0.134813	?																										
K	-0.04679	-0.44498	-0.10244	-0.6194	0.907973	0.904625	-0.10397	0.544205	-0.04174	-0.04374	-0.27979	-0.09346	0.465425	-0.44166	?																									
Li	-0.08982	0.088375	-0.06374	-0.4211	0.49234	0.91068	-0.04316	0.982165	-0.04962	-0.04363	-0.10334	-0.01948	0.959848	0.161986	0.506864	?																								
Mg	-0.02748	-0.04319	0.013119	-0.22141	0.450621	0.899667	-0.01396	0.522959	0.344016	0.009223	-0.06318	0.144156	0.54949	-0.2114	0.855524	0.561578	?																							
Mn	0.02563	-0.0061	0.58772	-0.37718	0.209652	-0.15651	0.196724	-0.01647	0.079336	0.26671	0.033292	0.597032	0.389017	-0.04343	-0.13132	-0.03123	0.178096	?																						
Mo	-0.00956	0.341573	-0.01568	0.175137	0.157814	0.179364	-0.09262	0.009261	0.096927	-0.12453	-0.05417	-0.07873	-0.01244	0.028021	0.005703	-0.07175	0.136121	-0.00814	?																					
Na	-0.00773	-0.05104	0.357987	-0.38468	0.178067	0.913212	0.220037	0.010758	0.077343	0.901044	0.016741	0.520793	0.399557	-0.06265	0.343456	0.288409	0.157749	0.371742	-0.10326	?																				
Ni	-0.07441	0.005651	0.479395	-0.00387	-0.13381	-0.44576	0.769632	0.067008	-0.0248	0.027425	0.149373	-0.09719	-0.08122	0.089027	-0.13788	-0.04162	0.016158	-0.06417	-0.04528	-0.03729	?																			
Pb	-0.03794	-0.02101	0.825106	-0.2822	-0.03802	0.541325	0.83307	0.1203	-0.11447	0.775316	0.126876	0.356635	0.187663	0.12158	-0.04563	0.007478	0.102706	0.522889	-0.11316	0.531501	0.662668	?																		
Sb	0.341887	-0.14649	0.143693	-0.43916	-0.06492	-0.17211	0.081589	-0.04277	0.286741	0.20283	-0.80367	-0.07452	-0.00049	-0.05011	0.068582	-0.02904	-0.18741	0.272187	-0.09345	0.096291	0.013001	-0.01762	?																	
Se	-0.11959	-0.08895	-0.00677	-0.38818	0.544024	0.918322	-0.11445	0.354654	0.00193	-0.08408	-0.13195	-0.02154	0.313661	0.07177	0.468184	0.313092	0.577901	-0.08122	0.022212	0.143634	-0.07998	-0.03922	-0.01468	?																
Sn	0.065338	0.141994	0.076298	0.396958	0.123152	-0.07539	-0.05161	-0.08505	0.23537	-0.07697	-0.08223	0.027809	0.045231	-0.17146	0.165328	-0.14506	0.09944	-0.02624	0.203962	-0.04662	-0.10674	-0.09611	-0.29574	0.06738	?															
Sr	0.095712	-0.08116	-0.12082	-0.23507	0.70218	0.920302	-0.03609	0.46066	0.032683	-0.10283	0.153981	-0.1385	0.429739	-0.24618	0.634371	0.447697	0.80419	-0.32939	0.415891	0.2336	-0.0366	-0.00134	-0.41974	0.44567	0.402053	?														
Ti	0.230441	-0.07725	-0.08839	-0.03963	0.470489	0.830616	-0.00924	0.350307	0.214894	-0.10863	0.285296	-0.07349	0.27721	-0.24748	0.377555	0.31856	0.672981	-0.29882	0.169646	0.016493	0.006641	0.057535	-0.51602	0.309373	0.421512	0.815511	?													
Tl	0.077291	0.169185	0.243236	0.291302	-0.33503	-0.31741	0.151025	-0.12814	0.088469	0.188393	0.233686	0.365544	-0.09058	0.257562	-0.32532	-0.09785	-0.32615	0.60681	-0.09467	0.152081	0.217528	0.268982	-0.07917	-0.1901	-0.14618	-0.26597	-0.18904	?												
U	-0.01124	0.065652	-0.02653	-0.184	0.432216	0.877241	0.003353	0.34542	0.100342	0.055294	-0.12941	0.168732	0.505487	-0.10017	0.66431	0.461091	0.629342	0.108244	0.351451	0.189353	-0.07439	0.031359	-0.17467	0.475492	0.144231	0.94702	0.715419	-0.31752	?											
V	0.229888	-0.1665	-0.44393	-0.26238	0.339587	0.433578	0.098472	0.346739	0.442256	0.434935	-0.17568	0.627907	0.333703	0.011225	0.316831	0.331541	0.301342	0.79798	-0.11645	0.268742	0.347085	0.598809	-0.23728	0.32159	-0.33547	0.242504	0.132509	0.651189	0.178535	?										
W	0.031303	-0.28918	-0.11093	-0.18351	0.705254	0.941795	-0.04289	0.325735	0.029553	-0.1371	-0.071	-0.09044	0.259148	-0.4037	0.658162	0.294257	0.641623	-0.039852	0.081627	0.279857	-0.0724	-0.08545	-0.09043	0.386797	0.332034	0.526271	0.366172	-0.28029	0.531444	0.587177	?									
Y	-0.02299	0.053419	-0.05527	-0.03117	-0.02284	-0.33073	-0.03157	0.221694	0.705259	-0.01155	-0.08527	0.006141	0.16745	-0.06095	0.223197	-0.04393	0.476208	-0.03962	-0.03129	0.04393	0.158804	-0.02999	0.279224	-0.0642	0.063304	-0.13067	-0.28239	0.106702	0.129003	-0.20282	0.192175	?								
Zn	-0.03831	-0.14163	0.26518	-0.44413	0.158192	---	0.285794	-0.03561	-0.01688	0.496176	0.160613	0.676214	0.505345	-0.11622	---	---	0.160656	0.688868	-0.18357	0.672635	-0.14758	0.900341	0.997645	---	-0.05177	---	---	0.169912	---	---	-0.02129	?								
Au	---	---	---	---	---	---	-0.29526	---	---	0.995543	---	-0.11502	---	---	---	---	---	---	---	0.904422	---	---	0.838964	---	---	---	---	---	---	---	---	---	0.358884	-0.10803	?					
Te	S_%	-0.14012	0.054917	0.519995	0.022617	-0.05126	-0.10903	0.19451	-0.05366	-0.04877	0.343469	-0.05006	0.757853	0.007041	0.213859	-0.09857	-0.05653	-0.16669	0.396416	-0.0782	0.180773	0.213234	0.339144	0.0796	0.126243	0.041554	-0.16711	-0.17137	0.295254	-0.14415	0.821767	-0.16208	-0.13084	0.647153	0.283569	?				
SO4-S_%	-0.09227	0.137382	0.271134	-0.06949	-0.0376	-0.0662	-0.10157	0.032929	0.063466	0.088539	-0.28647	0.451823	0.078557	0.310305	-0.10457	0.015912	-0.19656	0.428206	-0.03971	0.17446	0.073579	0.170144	-0.15716	0.060197	-0.13463	-0.20206	-0.27371	0.231229	-0.22519	0.853516	-0.11609	-0.13169	0.114206	0.079889	0.645486	?				
IULPHIDE-	-0.1512	0.081787	0.492705	-0.04533	-0.03495	-0.0662	0.054872	-0.07403	-0.06273	0.235845	-0.21833	0.64528	-0.02266	0.251266	-0.08989	-0.0757	-0.161	0.305626	-0.03515	0.121673	0.067882	0.260936	0.06454	0.196485	0.001517	-0.14685	-0.23426	0.182965	-0.1426	0.853516	-0.16447	-0.08073	0.369134	0.238883	0.991987	0.666141	?			
TC_%	0.017949	-0.26907	-0.10205	-0.69195	0.811727	0.882126	-0.10233	0.711538	-0.04969	-0.05586	0.062605	-0.07712	0.589435	-0.23989	0.856285	0.637806	0.950129	-0.24686	-0.16358	0.148526	-0.20407	0.199421	-0.16998	0.55647	0.019269	0.741563	0.654992	-0.32841	0.686642	0.339396	0.555788	-0.09619	---	---	-0.09374	-0.10006				

	Ag	Al	As	Ba	Be	B	Bi	Ca	Cd	Co	Cr	Cu	Fe	K	Li	Mg	Mn	Mo	Na	Ni	Pb	Sb	Se	Sn	Sr	Ti	Tl	U	V	W	Y	Zn	Au	Te	S_%	SO4-S_%	IULPHIDE-	TC_%	CO3_%			
Ag	1																																									
Al	-0.20147	1																																								
As	-0.12747	-0.20069	1																																							
Ba	-0.20618	0.618059	-0.09995	1																																						
Be	-0.01397	0.238792	-0.16435	0.177066	1																																					
B	1	1	1	1	1	1																																				
Bi	-0.06743	-0.1888	0.525116	-0.07256	-0.12127	1	1																																			
Ca	-0.00572	-0.41363	0.455729	-0.39158	-0.23263	---	0.01539	1																																		
Cd	0.278837	0.011691	-0.18893	0.016597	0.124466	1	-0.3	0.068435	1																																	
Co	-0.00441	0.020609	0.737073	0.018394	-0.18712	1	0.130566	0.057688	-0.0568	1																																
Cr	-0.04658	0.520402	-0.46342	0.417088	0.261754	1	-0.35356	-0.20995	0.13394	-0.13618	1																															
Cu	0.880668	-0.10356	0.004712	-0.20738	0.044184	1	-0.02004	-0.06482	0.280666	-0.0069	0.011121	1																														
Fe	0.179411	-0.64638	0.509157	-0.69639	-0.21175	1	0.052958	0.440547	0.020236	0.162341	-0.43537	0.204254	1																													
K	-0.13062	0.471503	0.393	0.721611	0.145096	1	0.14904	-0.27446	-0.06197	0.127837	0.182289	-0.08068	-0.3601	1																												
Li	-0.19961	-0.02708	-0.19777	-0.07097	0.423619	---	0.420212	0.13774	-0.29135	0.352562	0.086689	-0.06111	0.127108	-0.00112	1																											
Mg	-0.02352	0.168333	0.056553	0.298959	0.264598	1	0.41367	0.079679	0.024116	0.195368	0.049175	-0.0569	0.475078	0.112318	0.46123	1																										
Mn	-0.0164	-0.26881	0.280211	-0.15377	0.007665	1	0.028746	0.732259	0.171606	-0.00387	-0.06303	-0.03518	0.243768	-0.13284	0.076799	0.358427	1																									
Mo	0.12445	-0.28535	0.042601	-0.32546	-0.16449	1	-0.07194	0.016653	-0.12944	0.188019	-0.19192	0.150018	0.535318	-0.15078	-0.16031	0.105756	-0.06905	1																								
Na	-0.07615	0.594174	-0.40839	0.039515	0.0576	1	-0.29235	-0.29237	0.000546	-0.11992	0.29858	-0.01014	-0.39167	-0.12183	-0.05884	-0.22766	-0.3577	-0.13727	1																							
Ni	0.223779	-0.16237	-0.49982	-0.25789	-0.02528	1	-0.17509	-0.03677	8.36E-05	0.125367	0.107459	0.301784	0.325588	-0.27089	0.393144	0.483308	-0.08576	0.27586	-0.0284	1																						
Pb	-0.03994	0.080723	-0.01469	0.22788	0.043184	1	-0.01976	-0.06259	0.148975	0.025924	0.097597	0.021538	-0.16827	0.093977	-0.06451	-0.0591	0.419139	-0.13123	-0.09305	-0.06139	1																					
Sb	-0.1318	-0.39347	0.8738	-0.248	-0.04425	1	0.435321	0.438219	-0.26379	0.595401	-0.43739	-0.08075	0.497016	0.253052	-0.09551	-0.13114	0.292627	-0.00213	-0.51009	-0.41901	0.022526	1																				
Se	0.662973	-0.44149	0.001154	-0.27992	-0.25737	---	0.4433	0.212712	0.68968	0.303449	-0.40862	-0.31998	0.203202	-0.25592	0.128503	0.305472	0.370431	0.190294	-0.51277	-0.22166	0.127647	-0.05725	1																			
Sn	-0.11147	-0.01455	-0.05738	0.482682	0.307041	1	-0.06546	0.278285	-0.19211	0.28109	0.605964	-0.09626	-0.09686	0.039666	0.078616	0.322783	0.298093	-0.22187	-0.15866	0.380827	0.186906	-0.06055	-0.1639	1																		
Sr	-0.13101	0.69284	-0.38747	0.663401	-0.03882	1	-0.1338	-0.25766	-0.04624	0.122638	0.359576	-0.13142	-0.67649	0.429538	0.271071	0.188821	-0.25347	-0.27508	0.414464	-0.14761	0.065275	-0.52636	0.216978	0.260907	1																	
Ti	-0.37384	0.39776	-0.14602	0.540972	0.418121	1	0.037584	0.481322	-0.50306	0.237815	0.211378	-0.18959	-0.28837	0.114271	0.213101	0.198792	0.162847	-0.32664	0.434568	0.113486	-0.110494	-0.19339	-0.27491	0.578809	0.594379	1																
Tl	0.176412	-0.11435	0.288935	0.106684	-0.07343	1	0.433869	-0.06572	0.317152	0.163043	-0.21231	0.25689	0.764835	0.122925	0.143691	0.561219	0.1387	0.090475	-0.58349	0.061912	-0.13748	0.218899	0.462403	-0.01922	-0.26817	-0.1864	1															
U	0.094581	0.374759	-0.12014	0.014425	-0.22622	1	-0.33521	-0.18618	0.107563	-0.17595	-0.1851	0.021606	-0.22082	0.088484	-0.35661	-0.36405	-0.03056	0.042795	0.629538	-0.42737	0.081893	-0.29281	-0.30826	-0.51734	-0.16601	-0.18277	-0.27572	1														
V	-0.11685	0.718254	-0.40978	0.400352	0.184841	1	-0.07488	-0.36135	0.01544	-0.09718	0.503859	-0.0594	-0.54027	0.262144	0.592256	0.562352	-0.22864	-0.33548	0.538682	0.014231	0.033924	-0.53545	0.04225	0.226746	0.558067	0.294531	0.08452	-0.14722	1													
W	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Y	0.195636	-0.34236	-0.48614	-0.296	0.459578	---	-0.03754	0.214616	0.055198	-0.03309	0.133249	0.045836	-0.29132	-0.17183	0.553081	0.283871	0.00916	-0.24653	0.004077	0.441725	0.157295	-0.45496	0.307212	0.012281	0.448139	0.114979	-0.12309	-0.206	0.250286	---	1											
Zn	0.024244	0.012246	-0.00312	0.185304	0.115405	1	-0.01471	-0.02646	0.282417	-0.01144	0.047361	0.04747	-0.0699	0.059219	0.235547	0.639595	0.53333	-0.06784	-0.15511	-0.06164	0.699102	0.036478	0.65287	0.06691	-0.03292	-0.1443	0.040018	-0.15163	-0.01196	1												
Au	0.106696	-0.20821	0.365755	-0.19349	-0.11197	---	0.438642	0.231726	0.003394	0.377913	-0.1187	0.057387	0.346675	-0.04539	---	---	0.164869	0.122464	-0.2216	0.00316	0.013788	0.751954	---	---	-0.22186	---	---	---	---	0.011973	1											
Te	---	---	---	---	---	---	0	---	---	0	---	---	---	---	---	---	---	---	---	---	---	---	0.336861	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
S_%	0.22298	-0.37815	0.390445	0.033327	-0.45873	1	-0.14432	0.431294	0.212131	0.303466	-0.20599	0.597565	0.115378	0.065383	0.203126	-0.02565	0.516055	0.288411	-0.48041	0.279315	0.002851	0.574733	-0.18262	0.077038	-0.20979	-0.12046	0.228227	-0.29748	-0.19057	1												
SO4-S_%	0.78089	-0.36858	0.192498	0.048091	-0.48965	---	-0.297	0.202443	0.783799	0.241581	-0.15145	0.713418	0.052226	-0.02049	-0.0725	0.122373	0.681864	0.32305	-0.42134	0.309035	0.006237	0.122216	-0.10394	0.06567	-0.05106	-0.27308	0.309333	-0.10661	-0.05145	---	0.002263	-0.09619	---	0.197281	0.91241	1						
IULPHIDE-	-0.16321	-0.24606	0.406733	0.108581	-0.3661	---	-0.06549	0.417249	-0.17166	0.271073	-0.13732	0.469713	0.088358	0.137903	0.207647	-0.08628	0.299658	0.191227	-0.33606	0.233403	0.016909	0.687394	-0.24896	0.115424	-0.27951	0.011108	0.103416	-0.26517	-0.27933	---	-0.17977	-0.22066	---	-0.01489	0.970588	0.797673	1					
TC_%	-0.20104	-0.15162	0.872616	0.056664	-0.52507	1	0.543978	-0.0048	-0.10193	0.267494	-0.40266	-0.21173	0.49086	0.457239	-0.40633	-0.15625	-0.03005	0.529834	-0.50988	-0.53131	-0.03341	0.894106	0.250571	-0.10348	-0.61622	-0.40851	0.243301	-0.09423	-0.48335	1												
CO3_%	-0.18452	-0.11974	0.917224	0.062718	-0.56788	1	0.567869	0.057132	-0.09976	0.313913	-0.51341</																															

	Ag	Al	As	Ba	Be	B	Bi	Ca	Cd	Co	Cr	Cu	Fe	K	Li	Mg	Mn	Mo	Na	Ni	Pb	Sb	Se	Sn	Sr	Ti	Tl	U	V	W	Y	Zn	Au	Te	S_%	SO4-S_%	IULPHIDE-	TC_%	CO3_%				
Ag	1																																										
Al	0.054142	1																																									
As	0.164838	0.053526	1																																								
Ba	0.052333	0.78142	-0.10201	1																																							
Be	0.012501	0.141647	0.203477	0.009086	1																																						
B	-0.19672	-0.32649	0.435442	-0.23314	0.381157	1																																					
Bi	0.007582	-0.08189	0.191441	-0.10987	0.206169	0.026678	1																																				
Ca	0.002153	-0.23916	0.185657	-0.42435	0.031212	-0.12901	0.203093	1																																			
Cd	-0.01473	-0.00814	-0.03808	-0.09167	0.089539	-0.40796	-0.12352	0.362565	1																																		
Co	0.004274	-0.05467	0.623806	-0.10695	0.05485	0.259419	0.291868	0.094327	-0.03226	1																																	
Cr	-0.01315	-0.19423	-0.13711	0.037291	-0.13693	0.033512	-0.16643	-0.47711	-0.12041	-0.0677	1																																
Cu	0.035895	-0.00434	0.104958	0.041095	0.082966	-0.04694	0.054925	-0.19874	-0.07771	0.103358	0.163485	1																															
Fe	-0.02689	-0.28727	0.305103	-0.58536	0.255477	0.239448	0.193778	0.564992	0.202039	0.127013	-0.50977	-0.11708	1																														
K	0.058066	0.79633	-0.05872	0.853593	0.085587	-0.25207	-0.07604	-0.42648	-0.17215	-0.09401	-0.05029	0.079675	-0.41211	1																													
Li	-0.3512	0.143278	-0.16983	-0.09167	0.082161	-0.03665	-0.27731	-0.21046	-0.09475	-0.06114	-0.23572	-0.26863	0.085239	0.065341	1																												
Mg	-0.32755	-0.14316	-0.0697	-0.46268	0.004945	-0.06078	-0.10007	0.194516	-0.20841	-0.04856	-0.26245	-0.30681	0.424505	-0.00886	0.336627	1																											
Mn	-0.01017	-0.19774	0.261862	-0.39014	0.049763	-0.06857	0.229982	0.864746	0.330857	0.1264	-0.48757	-0.19935	0.591546	-0.43016	-0.20176	0.099503	1																										
Mo	0.015354	-0.02372	0.076786	-0.08302	0.095424	0.117648	0.116828	0.154357	0.168927	0.064105	-0.06646	-0.01358	0.10997	-0.13579	-0.02403	-0.22399	0.15014	1																									
Na	0.010143	0.62896	0.059337	0.273201	0.105684	-0.20447	-0.03152	-0.01804	0.10787	0.029301	-0.15769	-0.07735	-0.10818	0.148571	0.000626	-0.33453	0.018209	0.074277	1																								
Ni	0.020415	0.092449	0.210311	-0.13589	0.251758	-0.11192	0.21624	0.23148	0.081994	0.37124	-0.18847	0.02362	0.392912	-0.17046	0.005872	-0.10592	0.286944	0.23005	0.292886	1																							
Pb	0.011032	0.030065	0.322423	0.026493	0.099762	-0.24809	0.086913	-0.0271	0.048693	0.080588	-0.01154	-0.02655	0.076981	-0.05207	-0.09765	-0.01239	0.135039	0.104149	0.071879	0.149146	1																						
Sb	0.262356	0.021454	0.451056	-0.12355	0.415215	0.363932	0.852334	0.38489	-0.33037	0.576641	-0.28172	-0.00039	0.329833	-0.01061	-0.26973	0.052256	0.3422	0.302183	0.090984	0.246906	0.088226	1																					
Se	-0.17998	0.044865	0.123198	-0.08033	-0.00668	0.053359	0.637568	0.365415	-0.5313	0.18034	-0.55013	-0.14557	0.118851	-0.13364	0.061986	0.002344	0.432146	0.272281	0.13983	-0.02111	0.140712	0.474777	1																				
Sn	0.07081	-0.04857	0.330306	-0.35576	0.461125	0.118409	0.451767	0.680555	-0.19872	0.324389	-0.20611	-0.0848	0.583666	-0.18968	-0.0292	-0.00418	0.692162	0.406845	0.039762	0.238398	0.38125	0.470999	0.313483	1																			
Sr	0.033796	0.680065	-0.06586	0.697623	0.078086	-0.17305	-0.09456	-0.2791	-0.04563	-0.07945	-0.01535	0.062282	-0.40124	0.575039	0.286268	-0.22701	-0.22969	0.046434	0.403912	-0.04069	0.104727	-0.06897	0.055802	-0.19172	1																		
Ti	0.26192	0.15061	0.227265	-0.23012	0.43423	0.043398	0.232289	0.436161	0.051119	0.336106	-0.12816	0.234961	0.467589	0.016937	0.322517	0.170921	0.391801	0.102767	0.095366	0.21852	0.214002	0.305503	0.086327	0.543034	0.358021	1																	
Tl	-0.04474	0.025608	0.154134	-0.3231	0.205114	0.00355	-0.24008	-0.16763	0.144729	-0.03842	-0.07292	-0.05264	0.436471	0.10284	0.366631	0.478551	-0.05954	-0.10612	-0.36298	0.116868	0.188989	-0.1769	-0.20063	0.077147	-0.14476	0.354654	1																
U	0.131897	0.047379	0.109149	-0.00725	0.349418	-0.26885	0.310307	0.279268	0.119824	0.182818	-0.02065	0.06464	0.217299	-0.04373	-0.03081	-0.19449	0.312162	0.909856	0.143279	0.26683	0.129701	0.324343	0.136416	0.426714	0.042169	0.152796	-0.01562	1															
V	0.036741	0.40086	0.150419	-0.00719	0.283417	0.038794	0.014044	0.165359	0.134607	0.045567	-0.25429	-0.12649	0.299149	0.060296	0.445059	-0.01905	0.180268	0.046814	0.475804	0.427505	0.026173	0.103754	0.096445	0.266334	0.106632	0.723235	0.289114	0.113547	1														
W	0.05983	-0.30188	0.429441	-0.52381	0.292649	-0.04525	-0.54932	0.042221	0.037105	0.315765	-0.15491	0.48738	0.532689	-0.52067	0.147993	0.217498	-0.20732	-0.54756	-0.2869	-0.55102	-0.22227	-0.14179	-0.55349	0.374529	-0.48769	0.630582	0.194856	-0.13867	0.592924	1													
Y	0.505774	0.362074	0.21712	0.021127	0.697264	-0.16459	0.458629	0.457581	0.141042	0.279284	0.065582	0.403606	0.363064	0.056201	0.013082	-0.0719	0.497682	0.457809	0.357135	0.463944	0.144144	0.436055	0.170874	0.525543	0.178938	0.431416	0.056396	0.578831	0.315297	0.012874	1												
Zn	-0.008	0.112646	0.070976	0.103283	0.108259	-0.15056	-0.02513	-0.01301	0.147149	-0.01993	-0.05413	-0.02639	0.023636	-0.00457	-0.0378	-0.03872	0.161325	0.068084	0.120651	0.137641	0.431701	-0.01721	-0.01318	0.090205	0.125828	-0.07178	0.011234	0.097778	0.102513	0.48323	0.12107	1											
Au	0.019092	-0.00721	0.148873	-0.05186	0.08097	---	0.104806	0.067517	-0.03884	0.262654	0.008171	0.008426	0.033015	-0.04083	0.795995	0.943847	0.073039	0.106052	-0.0214	0.187101	0.02241	0.106681	0.686957	0.946927	-0.00066	---	0.188313	-0.19854	0.054144	---	0.195826	-0.01275	1										
Te	0.677919	0.008692	---	-0.24783	-0.23474	---	-0.0991	-0.83437	-0.2	0.001859	0.859208	-0.07255	0.230534	-0.5205	0.799093	---	-0.88124	-0.54233	-0.57585	0.17952	-0.41354	-0.75353	0.1621	---	-0.26538	---	0.237779	-0.40341	0.279684	---	0.200442	-0.09022	0.141589	1									
S_%	0.445583	-0.12867	0.405957	-0.22371	0.120289	0.257877	0.250287	0.315923	0.007528	0.283217	0.000333	0.437896	0.275347	-0.25131	-0.24432	0.043938	0.306562	0.120355	-0.08668	0.115092	0.401559	0.442787	0.021327	0.199411	-0.12998	0.081209	-0.07078	0.129775	-0.07852	0.622465	0.140193	0.255282	0.360701	-0.0783	1								
SO4-S_%	0.339197	-0.12514	-0.01354	-0.18677	0.138968	0.073367	0.210782	0.440739	0.095796	0.001443	0.107502	0.162855	0.216883	-0.27985	-0.3256	-0.05834	0.444211	0.408495	0.021229	0.217232	0.400201	0.353763	0.049619	0.225051	-0.06727	-0.02555	-0.16868	0.373727	-0.08449	-0.47425	0.230311	0.206731	0.105746	0.006088	0.584522	1							
IULPHIDE-	0.419636	-0.13584	0.559745	-0.26982	0.193944	0.166896	0.238592																																				

	Ag	Al	As	Ba	Be	B	Bi	Ca	Cd	Co	Cr	Cu	Fe	K	Li	Mg	Mn	Mo	Na	Ni	Pb	Sb	Se	Sn	Sr	Ti	Tl	U	V	W	Y	Zn	Au	Te	S_%	SO4-S_%	IULPHIDE-	TC_%	CO3_%	
Ag	1																																							
Al	-0.41139	1																																						
As		0.39162	1																																					
Ba	0.406748	0.365008	0.023158	1																																				
Be	-0.61656	0.424293	-0.46221	-0.1484	1																																			
B						1																																		
Bi	-0.4562	-0.49251	-0.36595	-0.7557	0.066499	1																																		
Ca	-0.28338	0.555176	0.757911	-0.1415	-0.01582	1																																		
Cd	0.819687	-0.66182	-0.14944	-0.20365	-0.30907	1																																		
Co	-0.66836	-0.03475	0.657516	0.188323	-0.61272	1																																		
Cr	-0.31768	0.247236	-0.04063	0.657783	-0.01044	1																																		
Cu	0.76389	0.070764	-0.1405	0.188497	-0.05562	1																																		
Fe	-0.91818	0.577464	0.07206	-0.36762	0.707262	1																																		
K	0.303355	0.157658	-0.10375	0.863164	-0.26361	1																																		
Li	-0.5206	0.284094	-0.06463	-0.51884	0.6059	1																																		
Mg	-0.92816	0.633365	0.21075	-0.29717	0.640419	1																																		
Mn	-0.70732	0.437723	0.435605	-0.14623	0.132202	1																																		
Mo	0.81874	-0.53076	0.146469	0.146804	-0.65166	1																																		
Na	-0.26151	0.524052	0.370815	-0.30839	0.356839	1																																		
Ni	-0.67676	0.312294	-0.30463	-0.15148	0.748579	1																																		
Pb	0.787583	-0.25793	-0.00784	0.224664	-0.25092	1																																		
Sb	0.167598	0.628864	0.761291	0.002235	-0.03357	1																																		
Se	-0.15083	-0.6294	-0.3631	-0.78556	0.006586	1																																		
Sn	-0.46713	-0.09914	-0.34538	-0.62627	0.405493	1																																		
Sr	-0.33196	0.598658	0.675887	-0.2188	0.229233	1																																		
Ti	-0.61536	0.672934	0.193581	-0.32079	0.702223	1																																		
Tl	-0.83168	0.398101	-0.20482	-0.12112	0.608125	1																																		
U	0.622939	-0.10254	-0.11536	0.646703	-0.34849	1																																		
V	-0.71723	0.528753	0.313113	-0.52973	0.568072	1																																		
W							1																																	
Y	-0.72142	0.475471	0.084317	-0.28074	0.540486	1																																		
Zn	0.745869	-0.70547	-0.17483	-0.33927	-0.27186	1																																		
Au								1																																
Te									1																															
S_%	0.7335	-0.11988	-0.27321	0.267047	0.101451																																			
SO4-S_%	0.786979	-0.8681		-0.1918	-0.55582																																			
IULPHIDE-	-0.78698	0.868097		0.191804	0.55582																																			
TC_%	0.720581	-0.45976		0.367679	-0.44755																																			
CO3_%	0.264524	0.403527		0.790237	0.104014																																			

Notes:  
  Elements with positive correlation greater than 0.75  
  Elements with negative correlation lower than -0.75

	Ag	Al	As	Ba	Be	B	Bi	Ca	Cd	Co	Cr	Cu	Fe	K	Li	Mg	Mn	Mo	Na	Ni	Pb	Sb	Se	Sn	Sr	Ti	Tl	U	V	W	Y	Zn	Au	Te	S_%	SO4-S_%	IULPHIDE-	TC_%	CO3_%			
Ag	1																																									
Al	-0.22115	1																																								
As	-0.177	0.226283	1																																							
Ba	-0.24939	0.732511	0.263924	1																																						
Be	-0.32283	0.358525	0.395723	0.331174	1																																					
B	0.169031	0.897011	0.241575	0.919787	-0.87831	1																																				
Bi	-0.29963	0.220227	0.688864	0.172049	0.293448	0	1																																			
Ca	-0.15451	0.550165	0.555734	0.138242	0.258351	-0.71429	0.667891	1																																		
Cd	0.59399	0.110401	0.080536	0.253713	0.163338	0.526986	-0.15908	-0.04916	1																																	
Co	-0.23182	0.207562	0.540548	0.200393	0.286728	0.368752	0.391155	0.618012	-0.0028	1																																
Cr	-0.06842	0.225258	0.420254	0.165684	0.732115	-0.08398	0.260418	0.271062	0.382498	0.26977	1																															
Cu	0.131914	0.052177	0.110927	0.092853	-0.01103	0.901652	0.215504	-0.21276	0.340424	0.776105	0.057417	1																														
Fe	-0.23602	0.367567	0.847663	0.29559	0.492922	-0.79535	0.854208	0.692201	0.147228	0.776484	0.551809	-0.07943	1																													
K	-0.33031	0.646317	-0.02192	0.68646	0.092798	0.134401	-0.02211	0.056286	0.072485	-0.03899	0.013175	0.100373	0.072441	1																												
Li	-0.14188	-0.22246	-0.30863	-0.37485	0.05735	0.831522	-0.16506	0.034353	-0.32701	-0.20468	0.03165	-0.11574	-0.19847	-0.48977	1																											
Mg	-0.29625	0.401992	0.391261	0.107468	0.420011	-0.58168	0.60236	0.818516	-0.02428	0.468495	0.479099	-0.22262	0.662002	-0.03028	0.325162	1																										
Mn	-0.15653	0.399022	0.593275	0.241409	0.443863	-0.63122	0.36989	0.644183	0.240547	0.455981	0.498408	0.197562	0.674552	0.094226	-0.00277	0.784231	1																									
Mo	0.012176	0.008426	0.489658	0.095964	0.127203	-0.57533	0.619312	0.332922	-0.15799	0.413264	0.103179	-0.28077	0.460667	-0.06953	-0.39495	0.072124	0.064973	1																								
Na	-0.10136	0.609019	0.173413	0.357868	0.272582	0.845154	0.298839	0.547729	-0.17804	0.17985	0.109775	-0.2437	0.209158	0.015653	0.117965	0.454169	0.09718	0.32474	1																							
Ni	0.159491	0.152348	0.420268	0.129819	0.617436	0.560612	0.14504	0.243594	0.214873	0.407765	0.6757	0.291501	0.419761	-0.14216	-0.10898	0.248521	0.271885	0.278278	0.24636	1																						
Pb	0.36011	-0.12851	0.09228	-0.28941	-0.30323	0.629924	0.025663	0.153135	-0.07803	0.017007	-0.06464	-0.15331	-0.03873	-0.21343	0.027833	-0.08445	0.000419	0.01735	0.117625	0.057518	1																					
Sb	-0.09634	0.546268	0.610955	0.106911	0.411716	-0.72281	0.665939	0.916731	-0.03011	0.651455	0.47935	-0.12982	0.713499	-0.0523	-0.04268	0.641073	0.868867	0.397727	0.540147	0.351632	0.162826	1																				
Se	0.567209	-0.20608	-0.7644	-0.19091	-0.42292	-0.42673	-0.42432	-0.50329	0.468108	-0.43717	-0.43136	-0.206	-0.77011	-0.01939	0.102373	-0.38696	-0.52967	-0.55672	-0.23211	-0.55892	-0.05113	-0.58129	1																			
Sn	-0.30214	0.287597	0.801892	0.209876	0.523645	-0.73608	0.82856	0.627248	-0.01243	0.744473	0.522416	-0.14594	0.836343	0.121078	-0.26794	0.474683	0.691346	0.453571	0.13213	0.520607	-0.01601	0.607296	-0.73477	1																		
Sr	-0.09209	0.375873	-0.06135	-0.07054	0.391035	0.815744	0.089355	0.596611	-0.05139	0.025085	0.337849	-0.17638	0.122973	-0.08546	0.419487	0.725883	0.300062	-0.08615	0.584517	0.292115	-0.03198	0.488535	0.036712	0.081982	1																	
Ti	-0.24789	0.414196	0.331081	0.037302	0.430513	0.732467	0.529866	0.766466	-0.01152	0.379223	0.49657	-0.17204	0.595089	-0.02917	0.317045	0.938154	0.686967	0.035817	0.512808	0.251769	-0.08288	0.589189	-0.31652	0.439806	0.773546	1																
Tl	-0.23554	0.180271	0.475416	0.367156	0.334894	0.257143	0.603146	0.209336	0.257458	0.405336	0.293411	-0.03704	0.632016	0.272803	-0.08712	0.46647	0.227477	0.149767	-0.05047	0.153775	-0.32324	0.040115	-0.31075	0.483579	-0.02814	0.468008	1															
U	0.280572	0.215629	-0.04243	0.408765	-0.17584	-0.04284	-0.18322	-0.23773	0.001754	-0.12327	-0.22604	0.03154	-0.21624	0.099314	-0.35175	-0.54993	-0.25762	0.38612	0.300149	0.173158	0.299095	-0.10731	0.053524	-0.16853	-0.38153	-0.54595	-0.40403	1														
V	-0.22098	0.330291	0.127843	-0.0481	0.214837	0.575963	0.306957	0.664818	-0.03105	0.200755	0.267204	-0.15709	0.382278	-0.07075	0.497238	0.925483	0.38281	-0.19403	0.390668	0.065606	-0.07132	0.472492	-0.14099	0.240085	0.782673	0.933529	0.358008	-0.64021	1													
W	0.318132	0.742478	0.657374	0.775947	-0.93214	0.872486	0.042756	-0.38045	0.107449	0.763608	-0.54108	0.996522	-0.52531	-0.36113	0.569092	-0.29741	-0.31097	-0.58953	0.477198	0.088726	0.838642	-0.35639	-0.23658	-0.31537	0.669677	0.917282	0.603615	0.135615	0.880418	1												
Y	-0.14022	0.343662	0.318049	0.260325	0.38059	-0.68034	0.38651	0.475987	0.060731	0.283316	0.34516	-0.33312	0.412257	0.162235	-0.07624	0.499134	0.478852	0.144499	0.380185	0.424178	0.022437	0.33227	-0.25665	0.487474	0.358414	0.47417	0.271896	-0.07095	0.345461	-0.28455	1											
Zn	0.094925	0.365991	-0.11026	0.474023	-0.04385	0.349005	-0.11815	-0.0458	-0.02807	-0.05023	-0.07173	0.016404	-0.08722	0.099477	-0.04616	-0.07229	0.036876	-0.44819	0.497865	0.115799	0.221882	-0.05013	0.09555	-0.16148	-0.01361	-0.07928	-0.1798	0.758866	-0.12957	-0.07846	0.169037	1										
Au	---	---	0.610286	---	---	---	0.418023	---	---	0.73117	---	0.521787	---	---	---	---	---	---	---	0.367109	---	---	0.75465	---	---	---	---	---	---	0.043401	1											
Te	---	---	---	---	---	-0.38247	---	---	-0.30831	---	-0.19144	---	---	---	---	---	---	---	---	0.705832	---	---	0.481664	---	---	---	---	---	---	0.019742	-0.21151	1										
S_%	0.457168	0.339521	0.346489	0.446747	0.033465	-0.0866	-0.03683	0.218849	0.746194	0.841182	0.141735	0.908068	0.312153	0.119283	-0.32355	0.103654	0.239612	0.08704	0.177601	0.405984	0.05686	0.201411	-0.1701	0.223999	-0.05592	0.057963	0.330236	0.26106	-0.00985	0.402204	0.055592	0.13508	0.976924	0.00039	1							
SO4-S_%	0.090873	0.42259	0.628408	0.50722	0.179851	0.138013	0.154249	0.362831	0.346527	0.856149	0.180866	0.887697	0.54758	0.1099	-0.29318	0.206169	0.392437	0.275704	0.284116	0.304609	0.037447	0.404573	-0.22581	0.475582	-0.09551	0.139718	0.383714	0.269763	0.017888	0.603928	0.084156	0.165936	0.996802	-0.22177	0.939611	1						
IULPHIDE-	0.624525	0.209875	0.077518	0.321071	-0.05532	-0.28172	-0.15817	0.059747	0.880262	0.787333	0.090674	0.877882	0.071619	0.083639	-0.24495	0.030706	0.062673	-0.08275	0.085278	0.431125	0.031979	-0.00156	-0.10336	-0.02622	0.013463	0.005638	0.241034	0.1932	-0.00416	0.121951	0.036844	0.110828	0.942882	0.125036	0.980089	0.855867	1					
TC_%	-0.14238	0.354081	-0.06085	0.247473	-0.27581	0.699948	0.044069	0.168251	-0.11262	-0.25802	-0.25338	-0.21865	-0.11804	0.526546	-0.19078																											

	Ag	Al	As	Ba	Be	B	Bi	Ca	Cd	Co	Cr	Cu	Fe	K	Li	Mg	Mn	Mo	Na	Ni	Pb	Sb	Se	Sn	Sr	Ti	Tl	U	V	W	Y	Zn	Au	Te	S_%	SO4-S_%	IULPHIDE-	TC_%	CO3_%	
Ag	0.005428	?																																						
Al	0.16057	-0.1871	?																																					
As	0.007466	0.799978	-0.12776	?																																				
Ba	0.000967	0.022462	-0.0008	-0.03649	?																																			
Be	-0.02451	0.010955	0.028637	-0.02497	-0.20608	?																																		
B	0.041547	-0.18851	0.264205	-0.2105	0.057927	-0.02109	?																																	
Bi	0.021699	-0.40029	0.340532	-0.54278	0.089923	-0.05114	0.273765	?																																
Ca	-0.00496	-0.0773	-0.00614	-0.08263	-0.00365	-0.15288	0.00554	0.059317	?																															
Cd	0.0723	-0.17896	0.539659	-0.11252	0.017101	0.020355	0.431717	0.223188	0.004695	?																														
Co	-0.01408	-0.08785	-0.12237	0.051513	-0.02769	0.069194	-0.1705	-0.41723	0.081114	-0.1404	?																													
Cr	0.050993	0.000784	0.158976	-0.03086	-0.00026	-0.02582	0.119578	-0.11648	0.040536	0.098361	0.103661	?																												
Cu	0.000637	-0.46108	0.384433	-0.6973	0.092463	0.007735	0.31619	0.633408	0.020753	0.329523	-0.4028	-0.03515	?																											
Fe	0.01219	0.78907	-0.20832	0.847513	-0.02464	-0.07106	-0.18271	-0.52073	-0.1247	-0.17096	-0.04474	0.038303	-0.55127	?																										
K	-0.23371	-0.1407	-0.17524	-0.27331	-0.05011	0.063968	-0.13252	-0.08477	-0.12199	-0.17652	-0.24392	-0.17793	0.171003	-0.23656	?																									
Li	-0.17442	-0.43526	-0.09807	-0.51608	0.067914	0.002846	-0.052	0.394983	-0.14738	-0.08912	-0.18905	-0.17769	0.592207	-0.36908	0.414149	?																								
Mg	0.011398	-0.39992	0.346972	-0.53228	0.081516	-0.03501	0.296888	0.888061	0.171296	0.238582	-0.36785	-0.10517	0.627801	-0.54734	-0.06207	0.328887	?																							
Mn	0.001309	-0.04496	0.119525	-0.05717	0.009808	-0.02135	0.040227	0.09058	0.002821	0.031839	-0.02712	0.003051	0.055045	-0.05776	-0.10495	-0.07924	0.079288	?																						
Mo	-0.00566	0.684244	-0.09975	0.339515	0.05638	0.150574	-0.10521	-0.15717	-0.03066	-0.11876	-0.03718	-0.04211	-0.19288	0.190421	0.035673	-0.2648	-0.15069	-0.01302	?																					
Na	0.056356	0.092914	0.524598	-0.11229	0.083745	0.125724	0.333813	0.209068	0.012092	0.822259	-0.10785	0.062464	0.356397	-0.1497	0.018712	-0.08446	0.227782	0.068553	0.271389	?																				
Ni	0.009682	0.019043	0.023793	0.046237	0.023862	-0.11214	0.061767	-0.01523	0.044664	-0.01031	0.004015	-0.01596	0.000278	-0.01257	-0.09784	-0.0043	0.103812	0.012586	0.019302	0.009046	?																			
Pb	0.057289	-0.23281	0.544132	-0.33803	0.067602	-0.00046	0.791401	0.524206	-0.11664	0.514564	-0.2338	0.017712	0.471113	-0.25617	-0.14961	0.245109	0.510928	0.305353	-0.08033	0.384137	0.131846	?																		
Sb	0.046326	-0.16612	0.064064	-0.20511	-0.0763	-0.03123	0.436585	0.16293	0.028336	0.053399	-0.55798	-0.11695	0.105439	-0.17992	0.108149	0.085053	0.17722	0.13269	-0.06026	-0.004	0.082042	0.351822	?																	
Se	0.068595	-0.28463	0.009804	-0.54324	0.180492	0.246877	0.368323	0.697273	-0.08706	0.052509	-0.14149	0.087103	0.654377	-0.44647	0.12088	0.214873	0.696568	0.309464	0.082015	0.124658	0.099218	0.473222	0.197806	?																
Sn	0.004402	0.68235	-0.08898	0.615354	0.017283	0.101127	-0.16409	-0.31999	-0.0536	-0.08642	0.008913	-0.00662	-0.41759	0.465343	0.196097	-0.15555	-0.31594	-0.02858	0.561738	0.007181	0.066599	-0.15766	-0.05235	-0.16021	?															
Sr	0.088209	0.032851	0.063354	-0.30854	0.087667	0.424479	0.115396	0.352377	-0.03533	0.114641	-0.00124	-0.08631	0.405349	-0.33419	0.365784	0.274085	0.348422	0.03359	0.50541	0.445853	-0.03233	0.193009	-0.02	0.585533	0.436689	?														
Ti	-0.08063	-0.29928	-0.1467	-0.3173	0.036031	0.013142	-0.06926	0.081801	0.08974	-0.10006	-0.01439	-0.06413	0.569887	-0.28377	0.424987	0.563	0.150157	-0.07383	-0.23927	-0.0362	0.103724	0.116161	-0.06829	0.151992	-0.08258	0.460404	?													
Tl	0.019321	0.144269	0.014951	0.067053	0.068185	-0.09056	0.189231	0.270329	0.00492	0.012619	0.01853	0.135365	-0.00063	0.08322	-0.28719	-0.28548	0.300925	0.664507	0.12243	0.041778	0.081657	0.186527	-0.04436	0.231469	-0.03675	-0.15928	-0.28133	?												
U	0.004277	0.400521	-0.03966	0.008627	0.098259	0.486409	-0.0425	0.074782	0.00854	-0.04937	-0.05948	-0.07997	0.199715	-0.03895	0.444763	0.135428	0.082637	-0.00854	0.647036	0.218562	-0.00884	0.065002	0.035923	0.378967	0.392984	0.896786	0.340276	-0.12946	?											
V	0.529952	-0.39196	0.026388	-0.35409	0.102656	-0.03336	0.289954	0.246628	0.050529	0.129311	-0.26619	0.642775	0.421519	-0.3204	0.090723	0.399092	0.1769	-0.05419	-0.27508	-0.12712	-0.11194	0.424558	0.121461	0.362132	-0.36005	0.141396	0.199887	-0.17921	0.042833	?										
W	0.288503	0.065145	0.158905	-0.23225	0.134749	0.068116	0.407919	0.509684	0.04808	0.113547	-0.03303	0.466373	0.345661	-0.26647	0.130861	-0.05358	0.544518	0.394195	0.441941	0.198372	0.04021	0.345759	0.094846	0.563366	0.155524	0.540408	-0.04578	0.393057	0.385128	0.095311	?									
Y	-0.00279	-0.04843	-0.02514	-0.02982	-0.00784	-0.25972	-0.01452	-0.04216	0.960965	-0.00867	0.11062	0.050031	-0.05029	-0.06562	0.038357	-0.0425	0.085141	-0.00568	-0.0308	-0.01001	0.065662	-0.03847	0.085957	-0.08627	-0.0201	-0.153	-0.03706	0.040901	-0.01952	0.137551	-0.02632	?								
Zn	0.012563	-0.05427	0.059296	-0.09185	-0.00123	---	0.140191	0.178162	0.018398	0.167291	-0.07694	0.037489	0.10386	-0.09172	0.795995	0.106127	0.155494	0.145202	-0.02171	0.107752	-0.00336	0.096164	-0.04145	0.398094	-0.08241	---	-0.33271	0.339817	0.000972	---	-0.01293	-0.00557	?							
Au	0.677919	0.008692	---	-0.24783	-0.23474	---	0.008926	-0.83437	-0.2	-0.04245	0.859208	-0.00202	0.230534	-0.5205	0.795993	---	-0.88124	-0.54233	-0.57585	0.062632	-0.41354	-0.75353	0.015879	---	-0.26538	---	0.237779	-0.40341	0.279684	---	0.200442	-0.04929	0.945883	?						
Te	0.247962	-0.242	0.807738	-0.27087	0.010262	0.024658	0.217127	0.480489	-0.06482	0.654583	-0.06245	0.375041	0.35855	-0.22641	-0.21278	0.099545	0.481051	0.238207</																						

	Ag	Al	As	Ba	Be	B	Bi	Ca	Cd	Co	Cr	Cu	Fe	K	Li	Mg	Mn	Mo	Na	Ni	Pb	Sb	Se	Sn	Sr	Ti	Tl	U	V	W	Y	Zn	Au	Te	S_%	SO4-S_%	IULPHIDE-	TC_%	CO3_%				
Ag	1																																										
Al	0.634291	1																																									
As	0.059549	-0.41778	1																																								
Ba	0.935435	-0.12092	-0.35458	1																																							
Be	-0.97011	-0.037	0.60788	-0.42338	1																																						
B	-0.4865	0.252772	0.241575	-0.57229	0.565685	1																																					
Bi	-0.79074	-0.44537	0.890374	-0.34929	0.63979	0.048918	1																																				
Ca	-0.7626	0.124429	0.585547	-0.67563	0.401333	-0.03997	0.635843	1																																			
Cd	0.738415	0.194404	-0.3691	0.731566	-0.15048	-0.41794	-0.33878	-0.47696	1																																		
Co	-0.77298	-0.50159	0.80347	-0.24446	0.174143	0.149355	0.150484	0.48388	-0.3755	1																																	
Cr	0.495541	-0.14599	-0.68662	0.451461	-0.47488	0.139825	-0.64616	-0.80051	0.263527	-0.36072	1																																
Cu	-0.56378	0.017542	-0.21736	0.038406	-0.13913	0.307446	-0.07717	-0.1808	-0.15319	0.951588	0.071787	1																															
Fe	-0.82515	-0.10958	0.802863	-0.51693	0.799755	0.036373	0.888656	0.783925	-0.3652	0.540921	-0.77313	-0.19938	1																														
K	0.709576	-0.3369	-0.56033	0.785445	-0.58676	-0.5431	-0.44559	-0.7779	0.507879	-0.27167	0.741499	0.253538	-0.70925	1																													
Li	-0.80287	0.670908	0.151819	-0.37255	0.602197	0.845765	0.174469	0.520483	0.088731	-0.08381	-0.50164	-0.20515	0.502453	-0.70457	1																												
Mg	-0.88659	0.574925	0.322436	-0.5003	0.655963	0.355982	0.35743	0.721722	-0.13211	0.061443	-0.67252	-0.22601	0.709934	-0.81382	0.921941	1																											
Mn	-0.74007	-0.05867	0.705166	-0.54857	0.571535	-0.0294	0.784086	0.934548	-0.3983	0.512544	-0.76238	-0.1213	0.880526	-0.6836	0.483893	0.683361	1																										
Mo	-0.64668	-0.56681	0.687192	-0.28228	0.447074	-0.1016	0.905007	0.54578	-0.35998	0.711667	-0.48424	-0.07086	0.754769	-0.26671	-0.02985	0.167178	0.694985	1																									
Na	0.442464	0.692797	0.04988	-0.59578	0.276045	0.498185	-0.02739	0.411293	-0.27158	-0.22669	-0.51171	-0.11859	0.289957	-0.76168	0.619227	0.66062	0.211202	-0.18251	1																								
Ni	-0.88013	0.453485	-0.08283	0.027892	0.551618	0.800627	-0.06389	0.02122	0.202639	0.096676	-0.02366	0.177683	0.252411	-0.19511	0.690934	0.583005	0.093476	-0.16056	0.139718	1																							
Pb	-0.90171	-0.52379	0.621437	-0.24001	0.327723	0.459052	0.60576	0.437758	-0.34082	0.466191	-0.32652	0.028726	0.434341	-0.13868	-0.0912	0.040107	0.57802	0.46713	-0.3282	-0.14844	1																						
Sb	-0.76792	0.301577	0.411015	-0.67596	0.259632	-0.0673	0.460886	0.915744	-0.35029	0.340285	-0.81141	-0.00459	0.616183	-0.73803	0.549594	0.67412	0.781198	0.379129	0.526637	-0.01536	0.238553	1																					
Se	-0.73898	-0.49959	0.888858	-0.36664	0.60322	-0.09137	0.782393	0.557423	-0.3053	0.421507	-0.56488	0.230539	0.790751	-0.42873	0.114377	0.30528	0.660714	0.682546	-0.03393	0.049822	0.577605	0.399087	1																				
Sn	-0.88139	-0.32786	0.869521	-0.50399	0.830108	0.160586	0.9061	0.668186	-0.40289	0.556587	-0.66129	-0.06767	0.943256	-0.60724	0.341291	0.533926	0.834498	0.779635	0.112462	0.168416	0.585282	0.484161	0.851068	1																			
Sr	-0.31965	0.775671	-0.08646	-0.54855	0.108625	0.915478	-0.12544	0.568776	-0.15942	-0.11083	-0.3915	-0.21137	0.198172	-0.71149	0.771945	0.736032	0.345045	-0.23671	0.77643	0.264421	-0.23927	0.666709	-0.12434	-0.00378	1																		
Ti	-0.87511	0.733053	0.120876	-0.54948	0.566844	0.790552	0.133175	0.580291	-0.122	-0.10309	-0.53018	-0.10241	0.512069	-0.76929	0.927759	0.944406	0.492344	-0.06621	0.737889	0.626939	-0.07845	0.615845	0.104882	0.350248	0.809612	1																	
Tl	-0.85763	0.311586	0.328137	-0.07942	0.665634	0.580955	0.344149	0.371615	0.065409	0.086237	-0.3685	-0.29551	0.590154	-0.40245	0.643069	0.742761	0.47201	0.141433	0.191892	0.710967	0.230773	0.17545	0.280708	0.487358	0.243342	0.665554	1																
U	0.280208	-0.72907	0.015383	0.322449	-0.2507	-0.6408	0.080865	-0.3222	-0.07289	0.033212	0.334556	0.228654	-0.24427	0.590803	-0.7638	-0.72234	-0.1475	0.197646	-0.72305	-0.46471	0.495491	-0.43549	0.004125	-0.03265	-0.79643	-0.78744	-0.38848	1															
V	-0.86811	0.74247	0.077206	-0.64185	0.434756	0.789384	0.079167	0.639578	-0.20109	-0.06922	-0.13794	0.452383	-0.7992	0.875879	0.902098	0.485961	-0.08677	0.780874	0.491447	-0.09837	0.706407	0.067898	0.274376	0.89228	0.973793	0.536378	-0.80069	1															
W	-0.57678	-0.07874	0.657374	-0.34762	0.436734	0.345789	0.731514	0.578491	-0.36972	0.876935	-0.79227	0.997015	0.573746	-0.50723	0.539307	0.527161	0.573185	0.391154	-0.46433	0.393261	0.852766	0.672258	0.492495	0.587422	-0.00213	0.528765	0.691059	0.246725	0.457989	1													
Y	-0.93345	0.201271	0.534016	-0.60144	0.728997	0.362994	0.580748	0.796754	-0.2379	0.180186	-0.74361	-0.13497	0.809111	-0.72498	0.653473	0.817681	0.842486	0.41015	0.4246	0.295343	0.47513	0.707717	0.516021	0.760784	0.432535	0.735526	0.675192	-0.3141	0.700911	0.57576	1												
Zn	-0.94729	0.348538	0.016488	-0.20944	0.489973	0.706328	-0.01054	0.323425	0.067002	0.612652	-0.03836	0.646236	0.314746	-0.31974	0.723581	0.629892	0.380816	-0.0148	0.091244	0.686604	0.165792	0.225784	0.256064	0.272531	0.479015	0.649167	0.641643	-0.48166	0.572832	0.46061	0.454814	1											
Au	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Te	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
S_%	-0.7133	-0.35373	0.785856	-0.09048	0.592236	0.022556	0.091451	0.410119	-0.14966	0.943573	-0.48884	0.955734	0.692093	-0.26157	0.219077	0.306651	0.610156	0.61965	-0.25614	0.297047	0.520069	0.304553	0.413829	0.776186	-0.22001	0.147849	0.398622	0.095844	0.043011	0.776551	0.445104	0.723549	1										
SO4-S_%	-0.63557	-0.48881	0.923812	-0.49577	0.53886	0.08165	0.020132	0.843596	-0.65855	0.986915	-0.96164	0.931229	0.810768	-0.72001	0.378968	0.730334	0.840042	0.60765	-0.75677	0.316142	0.845092	0.853367	0.338213	0.842309	-0.14407	0.526055	0.770815	0.352962	0.480407	0.837113	0.767421	0.708012	1										
IULPHIDE-	-0.61394	-0.75641	0.813838	-0.51489	0.509902	-0.06934	-0.36221	0.716388	-0.54908	0.91132	-0.76815	0.954759	0.692041	-0.62503	0.143032	0.576352	0.682797	0.39756	-0.75512	0.570276	0.752213	0.733877	0.107664	0.780835	-0.25909	0.386361	0.548842	0.063474	0.379801	0.569999	0.665184	0.866448	1										
TC_%	-0.8377	-0.50042	-0.08085	-0.59207	0.690328	0.197202	0.810625	0.756685	-0.38827	-0.42929	-0.677																																

	Ag	Al	As	Ba	Be	B	Bi	Ca	Cd	Co	Cr	Cu	Fe	K	Li	Mg	Mn	Mo	Na	Ni	Pb	Sb	Se	Sn	Sr	Ti	Tl	U	V	W	Y	Zn	Au	Te	S_%	SO4-S_%	IULPHIDE-	TC_%	CO3_%					
Ag	1																																											
Al	-0.52268	1																																										
As	0.041394	-0.45009	1																																									
Ba	-0.37017	0.917335	-0.4264	1																																								
Be	-0.38368	0.038169	-0.08622	-0.08842	1																																							
B	-0.12841	0.062067	0.082441	0.119323	-0.11443	1																																						
Bi	0.70771	-0.28643	-0.13337	-0.16512	-0.06342	-0.13216	1																																					
Ca	-0.39967	-0.17013	0.140109	-0.21643	0.324592	0.073305	-0.39226	1																																				
Cd	0.498042	-0.26623	-0.07764	-0.26321	-0.46929	-0.20916	0.493117	-0.60679	1																																			
Co	0.108335	-0.39768	0.509549	-0.48665	-0.16743	0.015558	0.164579	-0.25689	0.423233	1																																		
Cr	-0.04513	-0.0002	-0.22008	-0.21346	0.194523	-0.27014	-0.2264	-0.10993	0.021991	0.023794	1																																	
Cu	0.427726	-0.35309	0.503363	-0.23563	-0.31023	0.105382	0.054561	-0.28881	0.410906	-0.06033	0.0336	1																																
Fe	0.448118	-0.8007	0.384949	-0.88661	0.142455	-0.00071	0.264241	-0.01503	0.409605	0.557628	0.184077	0.334844	1																															
K	-0.22242	0.82253	-0.40201	0.790431	-0.05197	0.056521	0.06469	-0.59755	0.130622	-0.16894	-0.06869	-0.10643	-0.54431	1																														
Li	-0.10972	0.441475	-0.3791	0.383885	0.127012	0.134863	0.038609	-0.05069	0.386082	-0.38094	-0.07662	0.0892	-0.11711	0.529512	1																													
Mg	-0.40165	0.127538	0.097038	0.087749	0.584049	0.278716	-0.39849	0.745234	-0.86826	-0.43328	0.003361	-0.36094	-0.17774	-0.2416	0.230328	1																												
Mn	-0.39328	-0.0713	0.049364	-0.12049	0.310498	0.055589	-0.33264	0.923127	-0.51379	-0.26805	-0.14255	-0.27963	-0.03562	-0.41629	0.316341	0.712832	1																											
Mo	-0.25081	0.226822	-0.2323	0.16555	-0.12033	-0.01628	-0.20489	0.351208	-0.00407	-0.27003	-0.18912	-0.22772	-0.29123	0.009807	0.341185	0.035081	0.373249	1																										
Na	-0.43966	0.527251	-0.32812	0.492749	0.13801	-0.00851	-0.43364	0.350288	-0.4626	-0.50399	0.154756	-0.3264	-0.5623	0.044213	-0.0078	0.403161	0.280976	0.228379	1																									
Ni	0.162083	-0.18792	0.027388	-0.26167	-0.25337	-0.18019	0.312415	-0.24279	0.394326	0.67487	0.152687	-0.19226	0.339742	-0.0335	0.085983	-0.36806	-0.2052	-0.14876	-0.29371	1																								
Pb	-0.28982	-0.09344	-0.05138	-0.03774	0.367307	-0.22407	0.269348	0.099453	-0.14916	-0.11633	-0.0376	-0.04427	0.016613	-0.09526	-0.24051	0.23204	0.016571	-0.13799	-0.06537	-0.15423	1																							
Sb	0.472017	-0.52055	0.409422	-0.45635	0.096992	-0.10176	0.615781	0.071802	0.062668	0.316533	-0.29491	-0.08513	0.424121	-0.37053	-0.21101	0.053123	0.059751	-0.19524	-0.3552	0.247058	0.021627	1																						
Se	0.286936	-0.1848	0.066788	-0.0435	0.109617	-0.2656	0.451295	0.222187	-0.21073	-0.17041	-0.37738	-0.14842	-0.08503	-0.16753	-0.1093	0.292305	0.218127	-0.01207	-0.14122	0.006485	0.217087	0.713864	1																					
Sn	-0.33802	0.141173	0.009261	0.043972	0.613664	0.169984	-0.33416	0.613199	-0.71795	-0.41319	0.080956	-0.30127	-0.08005	-0.13921	0.356252	0.886626	0.554264	0.04709	0.231437	-0.31464	0.211399	0.002499	0.232965	1																				
Sr	-0.33741	0.773769	-0.48687	0.797557	-0.04736	0.119031	-0.19898	-0.02631	-0.18032	-0.42933	-0.05077	-0.18	-0.64202	0.538499	0.428269	0.11625	0.074487	0.173146	0.726154	-0.13607	-0.17201	-0.4437	-0.2062	-0.00318	0.373249	1																		
Ti	-0.05353	-0.0219	-0.13039	-0.24492	0.353244	0.052514	-0.28801	0.48262	0.15175	-0.08712	0.401321	0.041767	0.378903	-0.18598	0.404781	0.630493	0.495778	0.350492	0.263326	0.198502	-0.23217	-0.14569	-0.27295	0.613928	0.147754	1																		
Tl	0.377979	0.018386	-0.21003	-0.10337	0.000264	0.124385	0.39401	-0.61369	0.607545	0.33864	0.262307	0.153998	0.42532	0.408287	0.720956	-0.41679	-0.4175	-0.20349	-0.4337	0.499864	-0.12447	0.072286	-0.20697	-0.1999	-0.05058	0.452108	1																	
U	-0.3698	0.30797	-0.00751	0.262	0.100362	0.42696	-0.27711	0.417496	-0.35042	-0.16403	-0.23518	-0.26013	-0.2169	0.107384	0.45304	0.442025	0.552751	0.375312	0.229303	-0.0279	-0.03144	-0.14853	-0.05002	0.275112	0.375626	0.240936	-0.06352	1																
V	-0.4984	0.324507	-0.13388	-0.00386	0.538044	0.08236	-0.34149	0.232385	-0.12594	0.027999	0.403727	-0.33363	0.108999	0.168849	0.40255	0.324944	0.289483	0.150741	0.241884	0.017049	-0.05154	-0.20654	-0.3004	0.433491	0.198938	0.926032	0.300341	0.250154	1															
W	0.1546	-0.00993	0.023559	0.013382	0.234061	0.174887	0.343566	0.112664	0.029976	-0.13355	-0.30306	0.572145	0.188537	0.126127	0.463398	0.383416	0.350467	0.147571	-0.23	-0.21725	0.057934	0.233933	0.076782	0.354835	0.05889	0.164419	0.406623	0.381018	0.126148	1														
Y	-0.04789	0.01515	-0.20977	-0.10078	0.056091	0.16885	-0.11657	0.62784	0.206532	-0.15697	0.037726	0.048574	0.175904	-0.12667	0.555931	0.609966	0.770004	0.465142	0.24628	0.224854	-0.26177	-0.04527	-0.06606	0.374982	0.276452	0.761201	0.278993	0.580583	0.595726	0.314533	1													
Zn	-0.18734	0.389369	-0.22802	0.486098	-0.0909	-0.13589	0.103005	0.060845	-0.20957	-0.26979	-0.39639	-0.2141	-0.57084	0.389514	0.224889	0.13338	0.155229	0.206362	-0.07397	-0.10528	0.077162	0.030966	0.442437	0.111192	0.21112	-0.40868	-0.21475	0.246882	-0.1969	0.128535	-0.04775	1												
Au	-0.51565	0.324103	-0.87051	0.443606	-0.15264	---	-0.46525	0.793277	---	-0.24401	-0.57181	-0.15743	-0.99653	-0.16227	---	0.182545	0.888083	0.979721	0.808289	-0.17503	---	-0.63913	---	-0.33272	---	-0.56973	0.588678	0.246481	---	---	0.145598	1												
Te	---	---	---	---	---	---	-0.47601	---	0.249788	---	---	---	---	---	---	---	---	---	---	-0.00435	---	---	-0.33283	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
S_%	-0.12564	-0.61579	0.959025	-0.52046	-0.22762	0.233292	-0.44501	0.385991	-0.46553	0.744943	-0.29117	0.188663	0.397299	-0.57629	-0.466	0.249811	0.248604	-0.18303	-0.05375	-0.13271	-0.14573	0.442456	-0.15814	-0.11318	-0.53029	-0.00072	-0.49236	0.115951	-0.10204	-0.10483	-0.05751	-0.33997	-0.37182	0.852744	1									
SO4-S_%	-0.32275	-0.12549	0.245455	-0.12299	0.372535	0.2401	-0.26707	0.244981	-0.37037	0.229525	-0.1246	-0.03671	0.347879	-0.07041	0.368846	0.355862	0.411778	-0.33411	-0.17553	-0.28597	-0.17102	-0.09257	-0.42549	0.143541	0.009958	0.11976	0.112345	0.314261	0.201056	0.341736	0.14469	-0.37093	0.922613	0.733908	0.151637	1								
IULPHIDE-	-0.09881	-0.65837	0.958013	-0.5629	-0.14506	0.213219	-0.5096	0.304976	-0.40465	0.736288	-0.23437	0.314018	0.485853	-0.58	-0.5417	0.281059	0.107362	-0.27956	-0.20983	-0.18382	-0.42432																							

	Ag	Al	As	Ba	Be	B	Bi	Ca	Cd	Co	Cr	Cu	Fe	K	Li	Mg	Mn	Mo	Na	Ni	Pb	Sb	Se	Sn	Sr	Ti	Tl	U	V	W	Y	Zn	Au	Te	S_%	SO4-S_%	IULPHIDE-	TC_%	CO3_%		
Ag	1																																								
Al	0.127581	1																																							
As	-0.09113	-0.10392	1																																						
Ba	-0.256	0.848933	-0.00745	1																																					
Be	0.390571	-0.81147	-0.09636	-0.89751	1																																				
B	0.606591	-0.63891	-0.06991	-0.88085	0.932388	1																																			
Bi	-0.20894	-0.06952	0.922897	-0.05476	-0.07096	-0.43104	1																																		
Ca	0.281101	-0.86469	-0.10678	-0.90628	0.977964	0.887652	-0.10014	1																																	
Cd	0.694249	0.464461	-0.21995	0.21093	-0.12104	0.185914	-0.09367	-0.1773	1																																
Co	-0.06557	-0.10205	0.963682	-0.0727	-0.0672	0.507876	0.971855	-0.08252	-0.15452	1																															
Cr	-0.63031	0.216345	0.243431	0.172896	-0.40092	-0.60561	0.141328	-0.37776	-0.20174	0.237293	1																														
Cu	-0.09637	-0.04885	0.255164	0.172931	-0.11736	-0.26822	-0.10305	-0.05028	-0.05985	-0.00603	0.04842	1																													
Fe	0.424009	-0.81248	0.001089	-0.9105	0.973762	0.933546	0.005167	0.961328	-0.1492	0.014618	-0.44962	-0.04656	1																												
K	-0.38939	0.758402	0.028957	0.834446	-0.89769	-0.78786	0.025688	-0.87134	0.267789	0.002403	0.443654	0.070835	-0.91604	1																											
Li	0.326054	-0.83815	-0.10994	-0.9211	0.971227	0.904625	-0.0914	0.975535	-0.18575	-0.09036	-0.44657	-0.10382	0.985549	-0.89874	1																										
Mg	0.342768	-0.84809	-0.06388	-0.93079	0.980924	0.91068	-0.04913	0.985006	-0.17401	-0.04132	-0.41921	-0.08136	0.991088	-0.90297	0.995839	1																									
Mn	0.390436	-0.7994	-0.12998	-0.90028	0.9795	0.899667	-0.09544	0.970864	-0.16095	-0.09387	-0.46958	-0.1229	0.982358	-0.92771	0.983245	0.985563	1																								
Mo	-0.08172	0.16568	0.445548	0.237362	-0.21781	-0.15651	0.400767	-0.20075	0.138895	0.433852	0.051291	0.32336	-0.17339	0.402753	-0.23387	-0.20523	-0.23987	1																							
Na	0.799259	0.543914	-0.16354	0.166575	-0.0396	0.179364	-0.13446	-0.15285	0.496516	-0.12521	-0.05695	-0.10366	-0.04955	-0.07427	-0.11786	-0.11108	-0.03797	-0.22679	1																						
Ni	0.739252	-0.30957	0.513587	-0.49475	0.419065	0.913212	0.482858	0.340113	-0.07875	0.533665	0.080264	0.061318	0.460886	-0.43209	0.374272	0.405504	0.378343	0.288473	0.136957	1																					
Pb	-0.09575	-0.04116	0.921585	-0.02888	-0.08988	-0.44576	0.996866	-0.11798	-0.08834	0.975661	0.164213	-0.06509	-0.0211	0.049072	-0.11818	-0.07347	-0.11773	0.434035	-0.1144	0.492537	1																				
Sb	-0.05183	-0.22507	0.932693	-0.18134	0.043968	0.541325	0.954104	0.035397	-0.09556	0.962841	0.177944	0.08214	0.122272	-0.04005	0.026358	0.072295	0.009149	0.429653	-0.23637	0.501137	0.947116	1																			
Se	0.039193	-0.07063	0.915949	-0.06565	-0.07169	-0.17211	0.991925	-0.09679	-0.12535	0.963357	0.117537	-0.05597	0.014839	0.015728	-0.07869	-0.03966	-0.08618	0.397625	-0.13396	0.473541	0.990605	0.942237	1																		
Sn	0.412021	-0.76959	-0.20894	-0.86112	0.966524	0.918322	-0.19984	0.955376	-0.15918	-0.19415	-0.4812	-0.08553	0.966566	-0.89713	0.975602	0.969033	0.98514	-0.26734	-0.02516	0.32333	-0.22429	-0.08196	-0.18675	1																	
Sr	0.219298	0.074971	-0.03566	0.165938	0.072494	-0.07539	-0.08078	-0.02487	-0.04278	-0.07825	-0.46853	0.046387	0.090784	-0.31399	0.04557	0.029281	0.096447	-0.13871	0.323791	0.076509	-0.08388	-0.18673	-0.08573	0.091785	1																
Ti	0.78842	-0.41315	-0.15281	-0.67776	0.824181	0.920302	-0.10395	0.747186	0.164794	-0.1255	-0.53817	-0.18886	0.84528	-0.82231	0.808104	0.806091	0.836579	-0.28089	0.444875	0.41212	-0.12492	-0.08127	-0.09235	0.835512	0.32989	1															
Tl	0.684094	-0.49214	-0.14025	-0.56768	0.782769	0.830616	-0.10299	0.727588	0.066351	-0.12613	-0.75531	-0.07574	0.807244	-0.84325	0.766665	0.766311	0.820457	-0.24376	0.247548	0.268238	-0.12855	-0.08303	-0.08902	0.813938	0.517945	0.889265	1														
U	-0.12971	0.378959	0.27762	0.372021	-0.43856	-0.31741	0.182136	-0.41495	0.254229	0.25579	0.299508	0.406149	-0.39109	0.605711	-0.42372	-0.41381	-0.46062	0.853002	-0.10792	0.121967	0.216472	0.257853	0.176343	-0.44981	-0.24075	-0.4373	-0.50985	1													
V	0.819484	-0.3454	-0.13984	-0.61433	0.77054	0.877241	-0.11066	0.68293	0.186957	-0.12308	-0.53734	-0.13434	0.796328	-0.80042	0.748501	0.747374	0.782547	-0.29043	0.519989	0.418664	-0.1301	-0.09697	-0.09923	0.784278	0.39196	0.991881	0.884233	-0.4286	1												
W	0.229888	-0.1665	-0.44393	-0.26238	0.339587	0.433578	0.098472	0.346739	0.442256	0.434935	-0.17568	0.627907	0.333703	0.011225	0.316831	0.331541	0.301342	0.79798	-0.11645	0.268742	0.347085	0.598809	-0.23728	0.32159	-0.33547	0.242504	0.132509	0.651189	0.178535	1											
Y	0.506086	-0.63279	-0.13827	-0.68324	0.894413	0.941795	-0.08546	0.853473	0.042544	-0.11682	-0.48439	-0.14773	0.842308	-0.69842	0.828827	0.840069	0.856362	0.00378	-0.01584	0.367785	-0.0975	0.00147	-0.0889	0.870645	0.072378	0.75778	0.763222	-0.29634	0.700665	0.587177	1										
Zn	-0.32753	-0.01993	-0.15666	-0.02444	-0.01547	-0.33073	-0.12166	-0.06888	-0.18977	-0.12883	-0.00845	-0.15434	-0.04336	-0.03794	-0.00207	-0.03317	-0.01953	0.117073	-0.11199	0.230508	-0.11215	-0.19114	-0.12753	-0.01155	0.238203	-0.07076	-0.07771	0.132087	-0.06736	-0.20282	0.019541	1									
Au	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Te	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
S_%	0.013833	-0.10122	0.691687	0.113548	-0.11436	-0.10903	0.362249	-0.06781	-0.14594	0.494358	0.185629	0.794304	-0.03209	0.050776	-0.12831	-0.083	-0.15101	0.427403	-0.13253	0.306978	0.422816	0.528063	0.391506	-0.16828	-0.00091	-0.21212	-0.1303	0.394939	-0.16475	0.821767	-0.16275	-0.20151	---	1							
SO4-S_%	0.039193	0.261366	-0.44393	0.2395	-0.15667	-0.0662	-0.07418	-0.13792	0.485123	-0.2778	0.08011	0.995753	-0.15918	0.456734	-0.17461	-0.15951	-0.17785	0.981139	-0.10616	0.380684	0.697994	0.257151	0.527046	-0.16769	-0.27588	-0.18969	-0.27585	0.906337	-0.22896	0.853516	0.118031	-0.17371	---	1							
IULPHIDE-	0.039193	0.261366	-0.44393	0.2395	-0.15667	-0.0662	-0.09889	-0.13792	0.485123	-0.28775	0.08011	0.996104	-0.15918	0.456734	-0.17461	-0.15951	-0.17785	0.981139	-0.10616	0.493	0.697994	0.257151	0.637444	-0.16769	-0.27588	-0.18969	-0.27585	0.906337	-0.22896	0.853516	0.118031	-0.16615	---	1							
TC_%	0.266957	-0.9103	0.124422	-0.9863	0.986018	0.882126	-0.34117	0.99976	-0.26147	0.699147	-0.59195	-0.18484	0.983638	-0.87981	0.997293	0.996294	0.981717	-0.23797	-0.22975	0.197461	-0.50852	0.644748	-0.18706	0.982312	-0.12137	0.742876	0.777809	-0.45559	0.665865	0.339396	0.92357	-0.06538	---	1							
CO3_%	0.271945	-0.9																																							

	Ag	Al	As	Ba	Be	B	Bi	Ca	Cd	Co	Cr	Cu	Fe	K	Li	Mg	Mn	Mo	Na	Ni	Pb	Sb	Se	Sn	Sr	Ti	Tl	U	V	W	Y	Zn	Au	Te	S_%	SO4-S_%	IULPHIDE-	TC_%	CO3_%					
Ag	1																																											
Al		1																																										
As		0.999878	1																																									
Ba		-0.29574	-0.2808	1																																								
Be		-0.98624	-0.98354	0.449592	1																																							
B						1																																						
Bi		0.691291	0.702481	0.485808	-0.56233		1																																					
Ca		0.27735	0.292306	0.835766	-0.11471		0.885959	1																																				
Cd		0.990072	0.992144	-0.15853	-0.95321		0.785995	0.409644	1																																			
Co		-0.63165	-0.64367	-0.55377	0.494801		-0.99604	-0.92003	-0.73435	1																																		
Cr		-0.97213	-0.96835	0.511464	0.99751		-0.50262	-0.04437	-0.92952	0.432287	1																																	
Cu		0.347827	0.333157	-0.99849	-0.49803		-0.44338	-0.80431	0.212589	0.492501	-0.55794	1																																
Fe		-0.3764	-0.3619	0.996332	0.524379		0.40923	0.785714	-0.24244	-0.48048	0.58312	-0.99953	1																															
K		0.838628	0.847024	0.272319	-0.73704		0.973327	0.755929	0.906867	-0.952	-0.68755	-0.21899	0.188982	1																														
Li		0.27735	0.292306	0.835766	-0.11471		0.885959	0.409644	-0.92003	-0.04437	-0.80431	0.785714	0.755929	1																														
Mg		0.05962	0.075187	0.935936	0.106218		0.762505	0.975595	0.19934	-0.81153	0.176075	-0.91515	0.902367	0.593735	0.975595	1																												
Mn		0.562737	0.575566	0.623231	-0.41834		0.986323	0.950281	0.673344	-0.99631	-0.35325	-0.57928	0.554025	0.9222	0.950281	0.858715	1																											
Mo		0.797017	0.787497	-0.81265	-0.88589		0.114566	-0.35921	0.704211	-0.03522	-0.9164	0.843469	-0.85954	0.339422	-0.35921	-0.55536	-0.05074	1																										
Na		0.976554	0.973076	-0.49445	-0.9987		0.519531	0.064018	0.936599	-0.44995	-0.99981	0.541504	-0.56702	0.701704	0.064018	-0.15667	0.37159	0.908346	1																									
Ni		-0.52844	-0.51513	0.967278	0.66151		0.270477	0.669106	-0.40386	-0.33005	0.712749	-0.97896	0.985441	0.019279	0.669106	0.815958	0.404421	-0.93392	-0.69881	1																								
Pb		0.137253	0.152691	0.905635	0.028383		0.810619	0.989743	0.275122	-0.85461	0.098804	-0.88095	0.866025	0.654654	0.989743	0.996957	0.89605	-0.48885	-0.0792	0.76841	1																							
Sb		-0.85098	-0.85907	-0.25003	0.752451		-0.96777	-0.74061	-0.91635	0.944683	0.70413	0.196409	-0.16626	-0.99973	-0.74061	-0.575	-0.91303	-0.36105	-0.71797	0.003809	-0.63703	1																						
Se		0	0	2.32E-16	-3.6E-16		0.114766	0	3.45E-16	-0.07445	0	-0.40534	0	4.86E-16	6.28E-16	3.45E-16	1.03E-16	-2.8E-16	1.65E-16	0.31529	-1.3E-16	4.43E-16	1																					
Sn		-0.78042	-0.77057	0.828088	0.873047		-0.08771	0.384271	-0.68479	0.008226	0.905262	-0.85766	0.873022	-0.31391	0.384271	0.57761	0.077681	-0.99964	-0.89673	0.943225	0.512219	0.335745	-1.6E-16	1																				
Sr		-0.24019	-0.22502	0.998337	0.39736		0.53538	0.866025	-0.10136	-0.60084	0.461084	-0.99366	0.989743	0.327327	0.866025	0.954678	0.667271	-0.77771	-0.44353	0.951046	0.928571	-0.30542	0	0.794399	1																			
Ti		-0.44491	-0.43089	0.987093	0.58684		0.339557	0.737043	-0.31461	-0.41327	0.642479	-0.99441	0.997176	0.114708	0.737043	0.867456	0.489945	-0.89549	-0.62727	0.995426	0.826033	-0.09174	-2.8E-16	0.907179	0.976221	1																		
Tl		-0.17386	-0.15847	0.992136	0.334259		0.591387	0.897918	-0.03371	-0.65363	0.39989	-0.98375	0.977787	0.390609	0.897918	0.972654	0.716211	-0.73333	-0.38178	0.927916	0.951589	-0.36925	-1.3E-16	0.751411	0.997701	0.959286	1																	
U		0.915724	0.909344	-0.65465	-0.96955		0.342896	-0.13207	0.850154	-0.26691	-0.98441	0.695232	-0.71694	0.549086	-0.13207	-0.3465	0.183164	0.972522	0.980753	-0.82502	-0.27232	-0.56824	2.76E-16	-0.96588	-0.60999	-0.76726	-0.55489	1																
V		-0.99394	-0.99554	0.188982	0.962103		-0.76651	-0.38125	-0.99952	0.713015	0.940478	-0.2427	0.272319	-0.89341	-0.38125	-0.16895	-0.65017	-0.72582	-0.94698	0.431944	-0.24527	0.903539	-1.5E-15	0.706991	0.132068	0.343806	0.06459	-0.86603	1															
W																																												
Y		0.27735	0.292306	0.835766	-0.11471		0.885959	0.409644	-0.92003	-0.04437	-0.80431	0.785714	0.755929	1																														
Zn		0.295386	0.310256	0.825282	-0.13339		0.791851	0.999823	0.426743	-0.79801	-0.06316	-0.82592	0.773931	0.768118	0.999823	0.971289	0.955974	-0.34158	0.082792	0.692457	0.986879	-0.75313	0.573604	0.366825	0.85646	0.724191	0.889474	-0.11339	-0.39858	1	0.999823	1												
Au																																												
Te																																												
S_%		-0.97073	-0.97435	0.057639	0.917663		-0.20792	-0.5	-0.99485	0.229615	0.887357	-0.41433	0.142857	-0.94491	-0.5	-0.29764	-0.74481	-0.62862	-0.89626	0.03654	-0.37115	0.952217	-0.17983	0.607397	0	0.216777	-0.06777	-0.79241	0.991241	1	-0.5	-0.03375												
SO4-S_%																																												
IULPHIDE-																																												
TC_%																																												
CO3_%																																												

Notes:  
  Elements with positive correlation greater than 0.75  
  Elements with negative correlation lower than -0.75

	Ag	Al	As	Ba	Be	B	Bi	Ca	Cd	Co	Cr	Cu	Fe	K	Li	Mg	Mn	Mo	Na	Ni	Pb	Sb	Se	Sn	Sr	Ti	Tl	U	V	W	Y	Zn	Au	Te	S %	SO4-S %	IULPHIDE-	TC %	CO3 %			
Ag	?																																									
Al	-0.19684	?																																								
As	-0.2676	-0.20741	?																																							
Ba	-0.04879	0.865235	-0.34278	?																																						
Be	0.569851	0.192057	0.374242	-0.07027	?																																					
B	-0.17418	-0.30161	0.451204	-0.19662	0.392446	?																																				
Bi	-0.39298	-0.01254	0.419954	-0.19265	0.183073	0.110001	?																																			
Ca	-0.59758	-0.14222	0.410552	-0.41591	0.180936	-0.09935	0.736775	?																																		
Cd	0.641677	0.066847	-0.27752	0.08278	0.21656	-0.45301	-0.40358	-0.52585	?																																	
Co	-0.2992	-0.1317	0.722947	-0.25611	0.213084	0.219274	0.395032	0.488284	-0.25936	?																																
Cr	0.393486	0.021103	-0.36917	0.337296	-0.44103	0.025556	-0.46624	-0.66454	0.075041	-0.41521	?																															
Cu	0.768583	0.138774	-0.02531	0.051898	0.427583	-0.04686	-0.14672	-0.31497	0.867582	-0.08832	-0.03544	?																														
Fe	0.362081	-0.38406	0.557952	-0.62596	0.624444	0.208694	0.334412	0.512426	-0.06383	0.476522	-0.70885	0.094639	?																													
K	-0.0262	0.795181	-0.39153	0.825228	0.008633	-0.24618	-0.3676	-0.53893	0.332614	-0.32766	0.176321	0.200435	-0.52656	?																												
Li	-0.38235	-0.35744	0.098059	-0.30646	0.002587	-0.08281	-0.29017	-0.11594	0.464553	0.263696	-0.13314	-0.36008	0.265867	-0.04055	?																											
Mg	-0.55222	-0.43785	0.065718	-0.47254	-0.1941	-0.11837	-0.096	0.293285	-0.33871	0.173762	-0.37866	-0.52921	0.274498	-0.24572	0.532347	?																										
Mn	-0.63655	-0.10139	0.45058	-0.36855	0.162415	-0.02613	0.808386	0.981119	-0.54399	0.520828	-0.62843	-0.31127	0.478719	-0.50924	-0.12736	0.203396	?																									
Mo	-0.02258	-0.05246	0.307257	-0.18629	0.234535	0.195941	0.716577	0.527706	-0.19856	0.328249	-0.38144	-0.0244	0.358695	-0.32352	-0.02913	-0.16375	0.562958	?																								
Na	-0.43381	0.77851	0.037987	0.708898	0.249328	-0.14919	0.3124	0.210492	-0.26446	0.126428	-0.18772	-0.08411	-0.10702	0.426904	-0.38786	-0.32442	0.244338	0.200759	?																							
Ni	0.212524	-0.1277	0.160961	-0.14841	0.346975	-0.08934	0.453862	0.346757	0.09069	0.337895	-0.37252	0.146117	0.365166	-0.20707	0.165284	-0.09216	0.389912	0.514153	0.124346	?																						
Pb	-0.55568	-0.1843	0.360741	-0.31123	0.035359	-0.24233	0.485108	0.575614	-0.40118	0.457768	-0.44174	-0.28784	0.35172	-0.35353	0.00594	0.341758	0.560049	0.352787	0.092822	0.2989	?																					
Sb	-0.57337	-0.06744	0.680854	-0.32413	0.277458	0.466914	0.906406	0.79433	-0.42856	0.648385	-0.58585	-0.10488	0.513116	-0.50119	-0.16581	0.026561	0.844115	0.667851	0.234353	0.380512	0.557318	?																				
Se	-0.3715	-0.01584	0.385433	-0.17864	0.14006	0.140746	0.99148	0.719766	-0.42142	0.36313	-0.43867	-0.15542	0.302433	-0.36539	-0.31041	-0.11222	0.796271	0.719393	0.311146	0.414021	0.452142	0.890042	?																			
Sn	-0.36696	-0.16134	0.48867	-0.4652	0.318849	0.131146	0.611862	0.84153	-0.50991	0.436826	-0.58526	-0.2234	0.668878	-0.5959	-0.13603	0.084694	0.839708	0.500175	0.139728	0.149331	0.444773	0.718458	0.605863	?																		
Sr	-0.21087	0.72829	-0.24317	0.587193	0.034263	-0.13007	0.023532	-0.17727	0.333385	-0.07456	-0.00975	0.369005	-0.43242	0.740861	-0.23458	-0.41948	-0.12378	0.049999	0.408854	0.015354	-0.12559	0.045899	0.030662	-0.27789	?																	
Ti	0.076071	-0.29274	0.532919	-0.59687	0.588512	0.00624	0.366168	0.69989	-0.16062	0.560551	-0.75607	0.49398	0.858735	-0.54661	0.181179	0.343779	0.687743	0.264342	-0.13915	0.285944	0.346512	0.579381	0.337706	0.766394	-0.34496	?																
Tl	0.444572	-0.37001	-0.09525	-0.39615	0.082072	-0.05174	-0.46178	-0.2792	0.245093	-0.0859	-0.14267	-0.0002	0.306331	0.022835	0.635537	0.589013	-0.33312	-0.24111	-0.5846	-0.10757	-0.09614	-0.3515	-0.47609	-0.21052	-0.28369	0.200567	?															
U	-0.67662	0.325044	0.327016	0.028572	0.314884	-0.21237	0.599966	0.581103	-0.16936	0.432122	-0.51482	0.046432	0.340005	-0.01214	-0.00806	-0.19715	0.623101	0.703115	0.467376	0.394972	0.397341	0.670211	0.594058	0.576281	0.44594	0.442226	-0.33733	?														
V	0.306929	-0.15171	0.377218	-0.28422	0.733057	-0.00687	0.179224	0.347043	-0.09738	0.318678	-0.49556	-0.03151	0.726367	-0.29994	0.210228	0.172421	0.314794	0.16369	0.080715	0.477112	0.143446	0.259021	0.135761	0.40938	-0.42676	0.865179	0.215419	0.085795	?													
W	0.082583	-0.25181	0.395802	-0.48748	0.254481	-0.09812	-0.54237	0.074824	0.031734	0.263479	-0.16097	0.503087	0.499909	-0.50438	0.112434	0.184925	-0.16771	-0.5502	-0.22331	-0.53229	-0.20875	-0.18045	-0.54527	0.375374	-0.44688	0.611429	0.161605	-0.05028	0.565544	?												
Y	0.576436	0.482317	0.245515	0.206191	0.639478	-0.11437	0.607482	0.612592	-0.59123	0.297632	-0.4301	0.605232	0.202013	-0.02455	-0.32126	-0.30802	0.632929	0.457468	0.680412	0.29112	0.326766	0.589901	0.600962	0.56152	0.517236	0.269392	-0.53362	0.707003	0.274452	0.06863	?											
Zn	-0.62518	0.325977	0.426462	0.020466	0.222121	-0.21434	0.438125	0.553052	0.021949	0.432781	-0.547	0.176623	0.19222	0.095997	-0.05856	-0.03026	0.572849	0.17929	0.358558	0.12066	0.287026	0.649761	0.41854	0.403537	0.5021	0.587644	-0.34881	0.650837	0.004311	0.448026	0.665176	?										
Au	0.779442	-0.46283	-0.34226	-0.76743	0.090534	---	-0.10816	-0.49275	---	0.032899	-0.21138	0.798749	0.57111	-0.47961	---	0.943847	-0.97871	0.97419	-0.48806	-0.2131	---	0.676782	0.530406	0.946927	-0.37422	---	0.737481	-0.13397	-0.0188	---	---	-0.373	?									
Te	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
S %	0.270341	-0.10912	0.399416	-0.21402	0.098667	0.2828	0.257804	0.310047	-0.31947	0.356368	-0.25716	0.378827	0.273862	-0.31884	-0.14136	0.030653	0.32227	0.168497	-0.04835	0.27995	0.583561	0.48317	0.261252	0.319028	-0.06114	0.294358	-0.09105	0.219342	0.120641	0.672016	0.238616	0.241689	---	-0.89826	?							
SO4-S %	0.053803	0.366791	-0.6286	0.545874	-0.34693	0.142106	-0.23882	0.345686	-0.28226	-0.50498	0.022764	-0.28062	-0.69123	0.224518	-0.51516	-0.59012	0.564722	0.638823	0.476324	0.306421	-0.1311	0.392233	-0.1177	-0.0941	0.365352	-0.70942	-0.5239	0.04019	-0.65141	-0.43772	0.377487	-0.56927	---	-0.96923	0.348071	?						
IULPHIDE-	0.198529	-0.49581	0.857728	-0.85363	0.643651	0.156911	-0.77611	0.013589	0.010628	0.399993	-0.28637	0.369975	0.904391	-0.61434	0.288106	0.398006	-0.2378	-0.68073	-0.49422	-0.39098	-0.18424	0.005666	-0.37148	0.464616	-0.74989	0.833609	0.376683	-0.27271	0.683492	0.682661	-0.09573	0.337925	---	-0.94961	0.953459	0.210302	?					
TC %	-0.1311	0.394029	-0.72768	0.9194	-0.85161	-0.26012	0.682528	-0.2643</																																		

# Attachment 3.I-Ib

## Comparison of Results of Geochemical Testing to Site-Specific Water Quality Objectives

Attachment 3.1.Ib  
Range of Composition of Geochemical Test Leachates - Type 1 Mine Rock Samples  
NICO Project, Fortune Minerals Limited

Geochemical Test			Shake Flask Extraction (SFE) <sup>(1)</sup>	Shake Flask Extraction (SFE) <sup>(1)</sup>	Synthetic Precipitation Leaching Procedure <sup>(2)</sup>	Synthetic Precipitation Leaching Procedure <sup>(2)</sup>	Net Acid Generation Test Leachate <sup>(3)</sup>	Net Acid Generation Test Leachate <sup>(3)</sup>	Humidity Cell Test Leachate <sup>(4)</sup>	Humidity Cell Test Leachate <sup>(4)</sup>	Humidity Cell Test Leachate <sup>(4)</sup>	Humidity Cell Test Leachate <sup>(4)</sup>	Humidity Cell Test Leachate <sup>(4)</sup>	Humidity Cell Test Leachate <sup>(4)</sup>
Mine Rock Classification Criteria			Type 1	Type 1	Type 1	Type 1	Type 1	Type 1	Type 1	Type 1	Type 1	Type 1	Type 1	Type 1
Parameter		Site Specific Water Quality Objective	Minimum Concentration	Maximum Concentration	Minimum Concentration	Maximum Concentration	Minimum Concentration	Maximum Concentration	Average - First Flush - Feldspar Porphyry 100859	Average - Steady State - Feldspar Porphyry 100859	Average - First Flush - Rhyolite 100863	Average - Steady State - Rhyolite 100863	Average - First Flush - Rhyolite 100872	Average - Steady State - Rhyolite 100872
pH	s.u.	6.5 to 9	9.0	9.0	9.9	8.9	7.4	6.9	7.4	7.4	7.4	6.8	7.4	7.5
Sulphate	mg/L	500	2.1	4.8	< 5	47	15	51	1.9	< 0.5	2.0	< 0.5	1.6	0.55
Calcium	mg/L		3.0	4.1	3.0	12	3.7	5.8	3.4	2.8	4.0	2.3	3.3	3.1
Iron	mg/L	1.5	0.29	0.30	0.22	4.8	0.02	0.03	< 0.02	< 0.02	< 0.02	< 0.01	< 0.02	< 0.02
Chloride	mg/L		1.6	3.4	#N/A	#N/A	< 2	< 2	1.1	#N/A	< 2	< 2	< 2	< 2
Mercury	mg/L		#N/A	#N/A	< 0.0001	< 0.0001	#N/A	#N/A	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Silver	mg/L		< 0.00001	< 0.00001	< 0.00001	0.0001	0.00004	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.00001	< 0.0001	< 0.0001
Aluminum	mg/L	0.41	0.26	0.37	0.34	7.4	0.07	0.17	0.08	0.10	0.10	0.02	0.07	0.06
Arsenic	mg/L	0.05	0.12	0.30	0.008	1.9	0.03	0.14	0.05	0.008	0.37	0.05	0.08	0.01
Barium	mg/L		0.43	0.49	0.20	0.97	0.22	0.38	0.003	< 0.001	0.004	0.0005	0.004	0.001
Beryllium	mg/L		< 0.00002	< 0.00002	< 0.005	< 0.005	< 0.00002	< 0.00002	< 0.005	< 0.005	< 0.005	< 0.00002	< 0.005	< 0.005
Boron	mg/L		0.05	0.06	0.06	0.29	0.38	0.44	0.02	< 0.01	0.02	< 0.002	0.02	< 0.01
Bismuth	mg/L		0.001	0.002	< 0.0003	0.08	0.0004	0.0004	< 0.0003	< 0.0003	< 0.0003	< 0.00001	< 0.0003	< 0.0003
Cadmium	mg/L	0.00015	0.000005	0.00001	< 0.0005	< 0.0005	0.000006	0.00004	< 0.0001	< 0.0001	< 0.0001	0.000005	< 0.0001	< 0.0001
Cobalt	mg/L	0.01	0.0004	0.001	0.0004	0.06	0.014	0.11	< 0.0003	< 0.0003	0.004	0.007	0.004	< 0.0003
Chromium	mg/L		< 0.0005	< 0.0005	< 0.001	0.002	0.02	0.03	< 0.001	< 0.001	< 0.001	< 0.0005	< 0.001	< 0.001
Copper	mg/L	0.022	0.005	0.007	0.001	0.07	0.003	0.007	< 0.0008	< 0.0008	0.002	< 0.0005	0.001	< 0.0008
Potassium	mg/L		15	16	#N/A	#N/A	6.8	9.9	2.5	#N/A	2.9	0.08	2.4	0.51
Lithium	mg/L		0.002	0.002	< 0.02	< 0.02	< 0.002	< 0.002	< 0.005	< 0.005	< 0.005	< 0.002	< 0.005	< 0.005
Magnesium	mg/L		0.55	0.66	0.49	2.7	1.8	2.2	0.37	0.06	0.38	0.06	0.41	0.08
Manganese	mg/L		0.002	0.002	#N/A	#N/A	0.005	0.010	0.007	0.005	0.01	0.024	0.004	0.005
Molybdenum	mg/L	0.073	0.01	0.04	0.0008	0.03	0.009	0.13	0.03	0.001	0.02	0.0002	0.01	< 0.0003
Sodium	mg/L		3.9	4.1	#N/A	#N/A	14	15	2.4	0.08	0.80	0.03	1.3	0.06
Nickel	mg/L		0.002	0.002	< 0.001	0.004	0.002	0.004	0.001	< 0.001	< 0.001	< 0.0001	< 0.001	< 0.001
Phosphorous	mg/L		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	< 0.1	< 0.1	#N/A	< 0.1	< 0.1	< 0.1
Lead	mg/L	0.0076	0.0001	0.0004	< 0.0002	0.008	0.00005	0.00005	< 0.0002	< 0.0002	< 0.0002	0.00003	0.0002	0.0002
Antimony	mg/L	0.03	0.01	0.02	0.002	0.01	0.007	0.02	0.007	0.0006	0.02	0.0006	0.04	0.005
Selenium	mg/L	0.005	0.001	0.001	< 0.005	< 0.005	< 0.001	0.002	< 0.005	< 0.005	< 0.005	< 0.001	< 0.005	< 0.005
Tin	mg/L		< 0.00001	< 0.00001	< 0.001	< 0.001	0.0001	0.0002	0.005	< 0.001	0.005	0.00005	0.005	< 0.001
Strontium	mg/L		0.02	0.02	0.006	0.03	0.02	0.02	0.02	0.004	0.02	0.001	0.03	0.004
Titanium	mg/L		0.001	0.003	< 0.003	0.10	0.0003	0.004	< 0.003	< 0.003	< 0.003	< 0.0001	< 0.003	< 0.003
Thallium	mg/L		< 0.000002	< 0.000002	< 0.0002	< 0.0002	< 0.00002	0.00002	< 0.0002	< 0.0002	< 0.0002	0.000004	< 0.0002	< 0.0002
Uranium	mg/L	0.027	0.003	0.006	0.0007	0.007	0.0002	0.006	0.02	0.002	0.01	0.0004	0.009	0.001
Vanadium	mg/L		0.001	0.001	< 0.0009	0.02	0.00028	0.003	0.0009	< 0.0009	< 0.0009	0.00006	< 0.0009	< 0.0009
Tungsten	mg/L		0.009	0.06	0.0009	0.01	0.01	0.10	0.008	< 0.0002	0.002	< 0.00003	0.003	0.0002
Yttrium	mg/L		0.0001	0.0001	0.0001	0.003	0.00003	0.00009	< 0.0001	< 0.0001	< 0.0001	0.000002	< 0.0001	< 0.0001
Zinc	mg/L	0.11	0.002	0.003	0.002	0.15	0.006	0.04	0.001	< 0.001	0.002	0.001	0.002	0.002

- 1) Range of concentrations measured in shake flask extraction leachates in geochemistry dataset. Used to estimate the potential composition of runoff that could result from the rapid dissolution of soluble mineral phases.
- 2) Range of concentrations measured in synthetic precipitation leaching procedure leachates in geochemistry dataset. Used to estimate the potential composition of runoff that could result from the rapid dissolution of soluble mineral phases.
- 3) Range of concentrations measured in net acid generation test leachates in geochemistry dataset. Used to estimate the potential composition of runoff that could result from the complete oxidation of sulphide minerals and dissolution of soluble mineral phases.
- 4) Summary of results of long-term, laboratory humidity cell tests. First flush chemistry calculated as the average concentration in the first five weeks of testing. Steady state chemistry calculated as the average composition in the last five weeks of testing.

#N/A indicates that the parameter was not measured in the geochemical test leachate.

Parameters that occur at concentrations in excess of the site specific water quality objectives highlighted in grey.

Attachment 3.Lib  
 Range of Composition of Geochemical Test Leachates - Type 2 Mine Rock Samples  
 NICO Project, Fortune Minerals Limited

Geochemical Test		Shake Flask Extraction (SFE) <sup>1)</sup>	Shake Flask Extraction (SFE) <sup>2)</sup>	Synthetic Precipitation Leaching Procedure <sup>3)</sup>	Synthetic Precipitation Leaching Procedure <sup>4)</sup>	Net Acid Generation Test Leachate <sup>5)</sup>	Net Acid Generation Test Leachate <sup>5)</sup>	Humidity Cell Test Leachate <sup>6)</sup>	Humidity Cell Test Leachate <sup>6)</sup>	Humidity Cell Test Leachate <sup>6)</sup>	Humidity Cell Test Leachate <sup>6)</sup>	Humidity Cell Test Leachate <sup>6)</sup>	Humidity Cell Test Leachate <sup>6)</sup>	Humidity Cell Test Leachate <sup>6)</sup>	Humidity Cell Test Leachate <sup>6)</sup>	Humidity Cell Test Leachate <sup>6)</sup>	Humidity Cell Test Leachate <sup>6)</sup>	Field Cell Leachate <sup>7)</sup>	Field Cell Leachate <sup>7)</sup>	
Mine Rock Classification Criteria		Type 2	Type 2	Type 2	Type 2	Type 2	Type 2	Type 2	Type 2	Type 2	Type 2	Type 2	Type 2	Type 2	Type 2	Type 2	Type 2	Type 2	Type 2	
Parameter	Site Specific Water Quality Objective	Minimum Concentration	Maximum Concentration	Minimum Concentration	Maximum Concentration	Minimum Concentration	Maximum Concentration	Average - First Flush Feldspar Porphyry 100913	Average - Steady State Feldspar Porphyry 100913	Average - First Flush Siltstone 100914	Average - Steady State Siltstone 100914	Average - First Flush Wacke 100881	Average - Steady State Wacke 100881	Average - First Flush BRSmt 100802	Average - Steady State BRSmt 100802	Average - First Flush Breccia 100925	Average - Steady State Breccia 100925	Minimum FC-2	Maximum FC-2	
pH	s.u.	6.5 to 9	10	9.3	10	8.8	7.7	7.8	7.6	7.3	5.3	7.5	7.2	7.3	7.0	7.0	6.3	7.8	8.1	
Sulphate	mg/L	500	3.8	13	2.6	30	52	120	2.0	<0.5	<5	1.0	1.9	<0.5	1.6	<0.5	1.5	<0.5	29	284
Calcium	mg/L	4.8	6.1	1.1	9.3	27	33	2.4	3.0	1.6	1.1	0.72	0.57	0.41	0.20	3.6	0.26	24	39	
Iron	mg/L	1.5	0.14	0.50	0.05	45	<0.01	0.02	0.02	<0.01	0.03	0.02	0.02	0.03	0.05	0.05	0.02	<0.010	0.02	
Chloride	mg/L	3.3	4.0	#N/A	#N/A	<2	<2	1.4	<0.2	<2	<0.2	<2	<2	<2	<2	<2	<2	<2	0.75	10
Mercury	mg/L	#N/A	#N/A	<0.0001	<0.0001	#N/A	#N/A	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010
Silver	mg/L	<0.00001	0.0003	<0.0001	0.0001	0.000001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010
Aluminum	mg/L	0.41	0.11	0.26	0.15	36	0.01	1.1	0.16	0.08	0.12	0.09	0.04	0.04	0.02	0.58	<0.01	<0.010	0.01	
Arsenic	mg/L	0.05	0.02	0.07	<0.005	0.46	0.006	0.27	0.04	0.007	0.009	0.003	0.05	0.04	0.005	<0.005	0.07	0.009	0.004	0.01
Barium	mg/L	0.28	0.47	0.31	2.1	0.14	0.21	0.001	<0.001	<0.001	0.0002	0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.002	0.04	0.17
Beryllium	mg/L	<0.00002	0.00011	<0.005	<0.005	<0.00002	0.00008	<0.005	<0.005	<0.00002	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.00002	<0.00050	<0.00050	<0.00050
Boron	mg/L	0.05	0.07	0.04	0.70	0.23	0.51	0.03	<0.001	0.006	0.02	<0.001	0.02	<0.001	0.02	<0.001	0.02	<0.001	0.09	0.61
Bismuth	mg/L	0.02	0.06	<0.0003	0.26	0.0021	0.06	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	0.0003	0.0003	0.007
Cadmium	mg/L	0.00015	0.00004	0.0001	<0.0005	<0.0005	0.00004	0.0001	<0.0001	<0.0001	0.00004	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00003	<0.00010	0.0001	
Cobalt	mg/L	0.01	0.0001	0.0004	<0.0003	0.02	0.009	1.2	<0.0003	<0.0003	0.00004	0.0003	<0.0003	<0.0003	<0.0003	<0.0003	0.0008	0.007	0.003	0.001
Chromium	mg/L	<0.0005	<0.0001	<0.001	0.02	0.0008	0.003	<0.001	<0.001	<0.0005	<0.001	<0.0005	<0.001	<0.001	<0.001	<0.001	<0.0005	<0.00040	<0.00040	<0.00040
Copper	mg/L	0.022	<0.0005	0.0008	<0.0008	0.04	0.002	0.46	0.001	0.0008	0.0008	<0.0005	<0.0008	<0.0008	0.001	<0.0008	0.002	<0.0005	0.001	0.004
Potassium	mg/L	11	11	#N/A	#N/A	11	16	3.8	0.47	5.2	0.26	3.3	1.1	5.3	1.5	0.21	1.9	8.0	38	
Lithium	mg/L	0.02	0.004	<0.02	0.02	<0.005	0.002	<0.005	<0.005	<0.002	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	#N/A	#N/A	
Magnesium	mg/L	0.41	1.0	0.40	15	0.04	4.4	0.22	0.06	0.15	0.04	0.19	0.22	0.15	0.11	0.50	0.10	3.9	7.6	
Manganese	mg/L	0.01	0.009	#N/A	#N/A	0.003	0.41	0.001	0.0009	0.0007	0.001	0.0008	<0.0007	0.0008	<0.0007	0.0008	0.001	0.006	0.04	
Molybdenum	mg/L	0.073	0.007	0.02	<0.0003	0.02	0.0008	0.12	0.01	<0.0003	0.03	<0.0001	0.02	<0.0003	0.004	<0.0003	0.001	0.00005	0.01	0.03
Sodium	mg/L	5.2	7.3	#N/A	#N/A	9.5	11	5.6	0.08	3.8	0.05	6.8	0.36	4.2	0.09	1.9	0.02	5.5	87	
Nickel	mg/L	0.0002	0.001	<0.001	0.009	0.002	0.16	<0.001	<0.001	<0.001	<0.001	0.0015	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.003	
Phosphorous	mg/L	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	#N/A	#N/A	
Lead	mg/L	0.0076	0.0002	0.0006	<0.0002	0.02	0.00002	0.00003	<0.0002	0.0002	0.00003	0.00002	<0.0002	<0.0002	0.0003	<0.0002	<0.0002	<0.00010	<0.00010	
Antimony	mg/L	0.03	0.06	0.08	0.02	0.20	0.001	0.04	0.0005	0.01	0.0004	0.002	0.0005	0.006	0.002	0.003	0.003	0.02	0.03	
Selenium	mg/L	0.005	0.04	0.07	<0.005	<0.005	0.11	0.17	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.04	0.10	
Tin	mg/L	<0.00001	<0.00001	<0.001	0.002	0.00004	0.00006	0.005	<0.001	0.003	0.00003	0.004	<0.001	0.003	<0.001	0.004	0.00006	<0.00020	<0.00020	
Strontium	mg/L	0.02	0.02	0.07	0.03	0.02	0.03	0.009	0.004	0.005	0.003	0.005	0.005	0.005	0.002	0.003	0.003	0.13	0.27	
Titanium	mg/L	0.002	0.007	<0.003	1.0	0.0004	0.0005	<0.003	0.003	<0.0001	<0.003	0.005	<0.003	<0.003	<0.003	<0.003	<0.003	0.003	0.0009	
Thallium	mg/L	<0.00002	0.0001	<0.0002	0.0004	0.000009	0.0002	<0.0002	<0.0002	0.000004	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.000006	<0.000050	0.00009	
Uranium	mg/L	0.027	0.0002	0.0006	<0.0002	0.004	0.00004	0.006	0.0003	<0.0002	0.002	0.00008	0.0003	0.0005	0.0002	<0.0002	0.00001	0.00001	0.01	
Vanadium	mg/L	0.0001	0.0006	0.001	0.003	0.00008	0.003	0.003	<0.0009	0.002	0.0001	0.001	<0.0009	0.002	<0.0009	0.0005	0.00005	0.0008	0.002	
Tungsten	mg/L	0.001	0.02	0.0003	0.11	0.0005	0.006	0.004	<0.0002	0.005	0.00001	0.0006	<0.0002	0.001	<0.0002	0.0008	<0.0003	#N/A	#N/A	
Yttrium	mg/L	0.00003	0.0002	<0.0001	0.006	0.000007	0.0006	<0.0001	<0.0001	<0.0001	0.000001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.000002	#N/A	#N/A	
Zinc	mg/L	0.11	0.001	0.002	0.04	0.26	0.006	0.40	<0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	0.001	0.006	

- 1) Range of concentrations measured in shake flask extraction leachates in geochemistry dataset. Used to estimate the potential composition of runoff that could result from the rapid dissolution of soluble mineral phases.
- 2) Range of concentrations measured in synthetic precipitation leaching procedure leachates in geochemistry dataset. Used to estimate the potential composition of runoff that could result from the rapid dissolution of soluble mineral phases.
- 3) Range of concentrations measured in net acid generation test leachates in geochemistry dataset. Used to estimate the potential composition of runoff that could result from the complete oxidation of sulphide minerals and dissolution of soluble mineral phases.
- 4) Summary of results of long-term, laboratory humidity cell tests. First flush chemistry calculated as the average concentration in the first five weeks of testing. Steady state chemistry calculated as the average composition in the last five weeks of testing.
- 5) Range of concentrations measured in field cell leachates.

#N/A indicates that the parameter was not measured in the geochemical test leachate.

Parameters that occur at concentrations in excess of the site specific water quality objectives highlighted in grey.

Attachment 3.1.lb  
Range of Composition of Geochemical Test Leachates - Type 3 Mine Rock Samples  
NICO Project, Fortune Minerals Limited

Geochemical Test			Shake Flask Extraction (SFE) <sup>(1)</sup>	Shake Flask Extraction (SFE) <sup>(1)</sup>	Synthetic Precipitation Leaching Procedure <sup>(2)</sup>	Synthetic Precipitation Leaching Procedure <sup>(2)</sup>	Net Acid Generation Test Leachate <sup>(3)</sup>	Net Acid Generation Test Leachate <sup>(3)</sup>	Humidity Cell Test Leachate <sup>(4)</sup>	Humidity Cell Test Leachate <sup>(4)</sup>	Humidity Cell Test Leachate <sup>(4)</sup>	Humidity Cell Test Leachate <sup>(4)</sup>	Humidity Cell Test Leachate <sup>(4)</sup>	Humidity Cell Test Leachate <sup>(4)</sup>	Humidity Cell Test Leachate <sup>(4)</sup>	Field Cell Leachate <sup>(5)</sup>	Field Cell Leachate <sup>(5)</sup>	Field Cell Leachate <sup>(5)</sup>	Field Cell Leachate <sup>(5)</sup>	Field Cell Leachate <sup>(5)</sup>	Field Cell Leachate <sup>(5)</sup>	
Mine Rock Classification Criteria			Type 3	Type 3	Type 3	Type 3	Type 3	Type 3	Type 3	Type 3	Type 3	Type 3	Type 3	Type 3	Type 3	Type 3	Type 3	Type 3	Type 3	Type 3	Type 3	
Parameter		Site Specific Water Quality Objective	Minimum Concentration	Maximum Concentration	Minimum Concentration	Maximum Concentration	Minimum Concentration	Maximum Concentration	Average - First Flush - BRS+mt 100890	Average - Steady State - BRS+mt 100890	Average - First Flush - BRS+mt 100977	Average - Steady State - BRS+mt 100977	Average - First Flush - BRS+mt 100907	Average - Steady State - BRS+mt 100907	Average - First Flush - Rhyolite 100932	Average - Steady State - Rhyolite 100932	Minimum FC-1	Maximum FC-1	Minimum FC-3	Maximum FC-3	Minimum FC-4	Maximum FC-4
pH	s.u.	6.5 to 9	9.8	9.1	10	7.9	7.4	3.2	7.6	7.0	7.3	7.2	7.3	4.6	5.8	4.7	7.3	8.0	7.1	8.0	7.5	7.9
Sulphate	mg/L	500	2.1	24	4.6	24	30	200	2.3	< 0.5	1.5	< 0.5	2.3	1.1	15.1	5.8	36	197	64	284	213	363
Calcium	mg/L		3.7	8.6	0.78	5.4	18	0.64	0.16	0.55	0.83	0.66	0.26	2.30	0.04	50	48	14	48	85	124	
Iron	mg/L	1.5	0.19	1.2	0.30	13	< 0.01	17	0.05	0.02	0.05	0.02	0.04	< 0.01	0.07	0.38	< 0.010	0.02	< 0.010	0.05	< 0.010	0.02
Chloride	mg/L		1.9	4.6	#N/A	#N/A	< 2	< 2	< 2	< 0.2	1.55	< 0.2	0.9	< 0.2	< 2	< 0.2	1.1	15	0.68	14	1.1	6.0
Mercury	mg/L		#N/A	#N/A	< 0.0001	< 0.0001	#N/A	#N/A	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Silver	mg/L		< 0.00001	0.00024	< 0.0001	0.0001	< 0.00001	0.00017	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.00001	< 0.00020	< 0.00020	< 0.00020	< 0.00020	< 0.00020	< 0.00020
Aluminum	mg/L	0.41	0.05	0.52	0.72	6.2	0.01	1.5	0.08	0.03	0.06	0.03	0.06	< 0.01	0.03	0.16	< 0.010	0.04	< 0.010	0.08	< 0.010	< 0.010
Arsenic	mg/L	0.05	0.33	2.9	0.04	1.4	0.59	6.9	0.42	0.12	0.12	0.01	0.11	0.03	0.02	0.002	0.08	0.14	0.02	0.04	0.05	0.05
Barium	mg/L		0.24	0.45	0.30	1.1	0.02	0.27	0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.0001	0.009	0.003	0.06	0.10	0.06	0.16	0.06	0.21
Beryllium	mg/L		< 0.00002	0.0002	< 0.005	< 0.005	< 0.00002	0.0005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.00002	< 0.005	0.00008	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.00050	< 0.00050
Boron	mg/L		0.04	0.09	0.08	0.45	0.05	0.74	0.03	< 0.01	0.02	< 0.01	0.03	< 0.002	0.02	< 0.002	0.06	0.19	0.11	0.28	0.12	0.36
Bismuth	mg/L		0.002	0.06	< 0.0003	0.24	0.0001	0.006	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	0.00003	< 0.0003	< 0.00001	0.000053	0.0003	0.0001	0.003	< 0.000050	0.0003
Cadmium	mg/L	0.00015	< 0.000003	0.0002	< 0.0005	< 0.0005	0.00004	0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.000003	< 0.0001	0.000006	0.0001	0.0002	< 0.00010	0.0001	< 0.00010	0.0001
Cobalt	mg/L	0.01	0.0005	0.001	< 0.0003	0.07	0.0008	14	0.0006	0.0003	< 0.0003	0.0003	0.0003	0.0004	0.20	0.01	0.002	0.006	0.002	0.004	0.001	0.006
Chromium	mg/L		< 0.0005	< 0.0005	< 0.001	0.003	< 0.0005	0.02	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0005	< 0.001	< 0.0005	< 0.00040	0.0005	< 0.00040	0.0006	< 0.00040	0.0005
Copper	mg/L	0.022	< 0.0005	0.003	< 0.0008	0.21	< 0.0005	9.5	< 0.0008	< 0.0008	0.0008	< 0.0008	0.03	< 0.0005	0.10	0.19	0.03	0.004	0.003	0.005	0.002	0.004
Potassium	mg/L		11	32	#N/A	#N/A	11	49	5.8	1.9	6.1	1.8	6.3	0.43	5.1	0.11	11	34	19	36	8	36
Lithium	mg/L		0.002	0.005	< 0.02	< 0.02	< 0.002	< 0.002	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.002	< 0.005	< 0.002	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Magnesium	mg/L		0.43	1.4	0.70	6.8	0.09	11	0.20	0.10	0.21	0.12	0.24	0.12	1.5	0.14	4.6	9.0	3.0	9.8	8.9	23
Manganese	mg/L		0.001	0.007	#N/A	#N/A	0.0008	0.56	0.001	< 0.0007	0.0008	0.0008	0.001	0.002	0.02	0.003	0.03	0.13	< 0.0020	0.02	0.06	0.26
Molybdenum	mg/L	0.073	0.003	0.01	< 0.0003	0.007	0.001	0.17	0.004	< 0.0003	0.0008	< 0.0003	0.0007	< 0.00001	0.0003	< 0.00001	0.03	0.12	0.01	0.05	0.01	0.01
Sodium	mg/L		4.1	9.2	#N/A	#N/A	0.64	12	6.7	0.09	4.7	0.11	4.6	0.03	1.1	0.03	7.6	70	13	103	4.5	34
Nickel	mg/L		< 0.0001	0.002	< 0.001	0.004	0.0009	0.17	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0001	0.008	0.0007	0.002	0.003	0.001	0.002	0.001	0.004
Phosphorous	mg/L		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.01	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Lead	mg/L	0.0076	0.00008	0.0007	0.0002	0.003	0.00002	0.008	0.0002	< 0.0002	< 0.0002	< 0.0002	0.006	0.00004	< 0.0002	0.0001	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010	< 0.00010
Antimony	mg/L	0.03	0.02	0.15	0.002	0.03	0.003	0.08	0.03	0.01	0.01	0.02	0.008	0.0007	0.0001	0.03	0.06	0.06	0.02	0.06	0.02	0.03
Selenium	mg/L	0.005	0.006	0.06	< 0.005	< 0.005	0.02	0.07	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.001	< 0.005	< 0.001	0.005	0.03	0.01	0.05	0.03	0.09
Tin	mg/L		< 0.00001	0.00001	< 0.001	< 0.001	0.00001	0.0001	0.005	< 0.001	0.004	< 0.001	0.005	0.000085	0.004	0.00002	< 0.00020	< 0.00020	< 0.00020	< 0.00020	< 0.00020	0.002
Strontium	mg/L		0.01	0.03	0.07	0.04	0.009	0.02	0.005	0.002	0.005	0.003	0.005	0.0008	0.008	0.0002	0.23	0.32	0.11	0.29	0.22	0.41
Titanium	mg/L		0.002	0.011	0.008	0.20	0.0005	0.005	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.0001	< 0.003	< 0.0001	0.0006	0.001	< 0.00030	0.003	< 0.00030	0.001
Thallium	mg/L		< 0.000002	0.0002	< 0.0002	< 0.0002	0.000003	0.0006	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.000006	< 0.0002	0.000005	< 0.000050	0.0001	0.00005	0.00006	< 0.000050
Uranium	mg/L	0.027	0.0001	0.008	< 0.0002	0.006	0.00008	0.03	0.0009	< 0.0002	0.001	< 0.0002	0.0009	0.00001	0.001	0.001	0.04	0.17	0.002	0.06	0.002	0.03
Vanadium	mg/L		0.0002	0.009	< 0.0009	0.005	0.0001	0.03	0.001	< 0.0009	0.001	< 0.0009	< 0.0009	0.00006	< 0.0009	0.00004	0.001	0.002	0.0006	0.001	0.0007	0.001
Tungsten	mg/L		0.002	0.29	0.0007	0.12	0.0006	0.23	0.0006	< 0.0002	0.005	0.0002	0.003	< 0.00003	0.0004	< 0.00003	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Yttrium	mg/L		0.00003	0.0002	0.0002	0.006	0.00002	0.007	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.000001	0.0003	0.0009	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Zinc	mg/L	0.11	0.001	0.005	0.007	0.16	0.006	0.79	0.002	< 0.001	0.001	< 0.001	0.03	< 0.001	0.009	0.002	0.002	0.01	< 0.0010	0.002	0.001	0.006

- 1) Range of concentrations measured in shake flask extraction leachates in geochemistry dataset. Used to estimate the potential composition of runoff that could result from the rapid dissolution of soluble mineral phases;
- 2) Range of concentrations measured in synthetic precipitation leaching procedure leachates in geochemistry dataset. Used to estimate the potential composition of runoff that could result from the rapid dissolution of soluble mineral phases;
- 3) Range of concentrations measured in net acid generation test leachates in geochemistry dataset. Used to estimate the potential composition of runoff that could result from the complete oxidation of sulphide minerals and dissolution of soluble mineral phase;
- 4) Summary of results of long-term, laboratory humidity cell tests. First flush chemistry calculated as the average concentration in the first five weeks of testing. Steady state chemistry calculated as the average composition in the last five weeks of testing;
- 5) Range of concentrations measured in field cell leachates.

#N/A indicates that the parameter was not measured in the geochemical test leachate

Parameters that occur at concentrations in excess of the site specific water quality objectives highlighted in grey

Attachment 3.1.Ib  
Range of Composition of Geochemical Test Leachates - Sub-economic Mineralized Mine Rock / Ore Samples  
NICO Project, Fortune Minerals Limited

Geochemical Test		Shake Flask Extraction (SFE) <sup>(1)</sup>	Shake Flask Extraction (SFE) <sup>(1)</sup>	Synthetic Precipitation Leaching Procedure <sup>(2)</sup>	Synthetic Precipitation Leaching Procedure <sup>(2)</sup>	Net Acid Generation Test Leachate <sup>(3)</sup>	Net Acid Generation Test Leachate <sup>(3)</sup>	Field Cell Leachate <sup>(4)</sup>	Field Cell Leachate <sup>(4)</sup>	
Mine Rock Classification Criteria		Sub-economic Mineralized Mine Rock / Ore	Sub-economic Mineralized Mine Rock / Ore	Sub-economic Mineralized Mine Rock / Ore	Sub-economic Mineralized Mine Rock / Ore	Sub-economic Mineralized Mine Rock / Ore	Sub-economic Mineralized Mine Rock / Ore	Sub-economic Mineralized Mine Rock / Ore	Sub-economic Mineralized Mine Rock / Ore	
Parameter	Site Specific Water Quality Objective	Minimum Concentration	Maximum Concentration	Minimum Concentration	Maximum Concentration	Minimum Concentration	Maximum Concentration	Minimum FC-5	Maximum FC-5	
pH	s.u.	6.5 to 9	9.8	7.8	10	9.4	6.7	2.2	7.5	7.8
Sulphate	mg/L	500	2.3	86	< 5	20	69	630	140	960
Calcium	mg/L		3.6	28	1.9	6.7	14	25	37	156
Iron	mg/L	1.5	< 0.01	1.1	1.8	15	< 0.01	39	<0.010	<0.010
Chloride	mg/L		1.5	6.8	#N/A	#N/A	< 2	3.1	0.80	21
Mercury	mg/L		#N/A	#N/A	< 0.0001	< 0.0001	#N/A	#N/A	<0.00010	<0.00010
Silver	mg/L		< 0.00001	0.00098	< 0.0001	0.0001	0.00001	0.00043	<0.00020	<0.00020
Aluminum	mg/L	0.41	0.05	0.49	0.44	5.6	< 0.01	12	<0.010	<0.010
Arsenic	mg/L	0.05	0.03	9.6	0.01	10	0.01	27	1.5	2.3
Barium	mg/L		0.01	0.43	0.37	0.91	0.04	0.19	0.06	0.21
Beryllium	mg/L		< 0.00002	0.0003	< 0.005	< 0.005	< 0.00002	0.001	<0.00050	<0.00050
Boron	mg/L		0.03	0.09	0.07	0.32	0.04	0.76	0.19	0.91
Bismuth	mg/L		0.0007	0.06	0.0005	0.11	0.00008	0.002	<0.00050	0.0001
Cadmium	mg/L	0.00015	< 0.000003	0.00031	< 0.0005	< 0.0005	0.00003	0.001	<0.00010	0.0003
Cobalt	mg/L	0.01	0.001	0.004	0.002	0.10	0.08	28	0.01	0.01
Chromium	mg/L		< 0.0005	< 0.0005	< 0.001	0.003	0.003	0.02	<0.00040	0.0006
Copper	mg/L	0.022	< 0.0005	0.001	< 0.0008	0.04	0.003	2.5	0.002	0.005
Potassium	mg/L		7.4	42	#N/A	#N/A	14	37	9.5	41
Lithium	mg/L		0.002	0.007	< 0.02	0.02	< 0.002	0.002	#N/A	#N/A
Magnesium	mg/L		0.27	3.2	0.88	2.4	2.8	15	8.1	36
Manganese	mg/L		0.001	0.007	#N/A	#N/A	0.006	0.92	0.02	0.18
Molybdenum	mg/L	0.073	0.002	0.02	< 0.0003	0.01	0.001	0.14	0.02	0.14
Sodium	mg/L		4.4	20	#N/A	#N/A	0.83	10	11	250
Nickel	mg/L		0.0001	0.003	< 0.001	0.006	0.004	0.30	0.002	0.005
Phosphorous	mg/L		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Lead	mg/L	0.0076	< 0.00002	0.001	< 0.0002	0.005	0.00003	0.006	<0.00010	<0.00010
Antimony	mg/L	0.03	0.013	0.12	0.03	0.03	0.002	0.06	0.03	0.09
Selenium	mg/L	0.005	0.003	0.10	< 0.005	< 0.005	0.01	0.13	0.003	0.05
Tin	mg/L		< 0.00001	0.00003	< 0.001	< 0.001	< 0.00001	0.00008	<0.00020	0.0006
Strontium	mg/L		0.01	0.06	0.008	0.02	0.01	0.03	0.25	0.99
Titanium	mg/L		0.0005	0.01	0.008	0.39	0.0005	0.009	<0.00030	0.001
Thallium	mg/L		< 0.000002	0.0003	< 0.0002	< 0.0002	0.000005	0.0007	<0.000050	0.0001
Uranium	mg/L	0.027	0.0001	0.008	0.0003	0.006	0.0005	0.09	0.01	0.34
Vanadium	mg/L		0.0002	0.006	0.002	0.01	0.00007	0.02	0.002	0.004
Tungsten	mg/L		0.003	0.24	0.0004	0.50	0.0002	0.05	#N/A	#N/A
Yttrium	mg/L		< 0.00001	0.0004	0.0002	0.002	0.00003	0.02	#N/A	#N/A
Zinc	mg/L	0.11	< 0.001	0.004	0.003	0.19	0.02	0.92	0.001	0.03

- 1) Range of concentrations measured in shake flask extraction leachates in geochemistry dataset. Used to estimate the potential composition of runoff that could result from the rapid dissolution of soluble mineral phases
- 2) Range of concentrations measured in synthetic precipitation leaching procedure leachates in geochemistry dataset. Used to estimate the potential composition of runoff that could result from the rapid dissolution of soluble mineral phases
- 3) Range of concentrations measured in net acid generation test leachates in geochemistry dataset. Used to estimate the potential composition of runoff that could result from the complete oxidation of sulphide minerals and dissolution of soluble mineral phase:
- 4) Range of concentrations measured in field cell leachates.

#N/A indicates that the parameter was not measured in the geochemical test leachate


Parameters that occur at concentrations in excess of the site specific water quality objectives highlighted in grey

**Attachment 3.I.Ib**  
**Range of Composition of Geochemical Test Leachates - Sediment / Overburden Samples**  
**NICO Project, Fortune Minerals Limited**

Geochemical Test		Shake Flask Extraction (SFE) <sup>(1)</sup>	Shake Flask Extraction (SFE) <sup>(1)</sup>
Mine Rock Classification Criteria		Sediment / Overburden	Sediment / Overburden
Parameter	Site Specific Water Quality Objective	Minimum	Maximum
pH	s.u.	6.5 to 9	7.4
Sulphate	mg/L	500	1.2
Calcium	mg/L		0.25
Iron	mg/L	1.5	0.43
Chloride	mg/L		1.1
Mercury	mg/L		< 0.0001
Silver	mg/L		< 0.00001
Aluminum	mg/L	0.41	0.41
Arsenic	mg/L	0.05	0.0052
Barium	mg/L		#N/A
Beryllium	mg/L		< 0.00002
Boron	mg/L		0.062
Bismuth	mg/L		0.00004
Cadmium	mg/L	0.00015	< 0.000003
Cobalt	mg/L	0.01	0.00016
Chromium	mg/L		< 0.0005
Copper	mg/L	0.022	0.004
Potassium	mg/L		2.6
Lithium	mg/L		< 0.001
Magnesium	mg/L		0.14
Manganese	mg/L		0.003
Molybdenum	mg/L	0.073	0.0006
Sodium	mg/L		4.5
Nickel	mg/L		0.0003
Phosphorous	mg/L		#N/A
Lead	mg/L	0.0076	0.00009
Antimony	mg/L	0.03	0.001
Selenium	mg/L	0.005	< 0.001
Tin	mg/L		0.00006
Strontium	mg/L		0.007
Titanium	mg/L		0.007
Thallium	mg/L		< 0.00002
Uranium	mg/L	0.027	0.0003
Vanadium	mg/L		0.0004
Tungsten	mg/L		0.0004
Yttrium	mg/L		0.0001
Zinc	mg/L	0.11	0.003

1) Range of concentrations measured in shake flask extraction leachates in geochemistry dataset. Used to estimate the potential composition of runoff that could result from the rapid dissolution of soluble mineral phases.

#N/A indicates that the parameter was not measured in the geochemical test leachate.

 Parameters that occur at concentrations in excess of the site specific water quality objectives highlighted in grey.