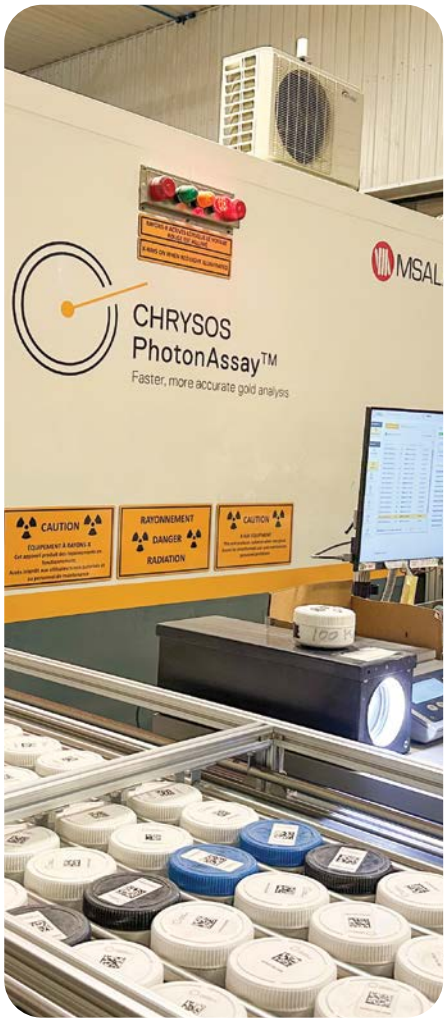
MSALABS

Schedule of Services

2025



msalabs.com

CONTENTS

ABOUT MSALABS

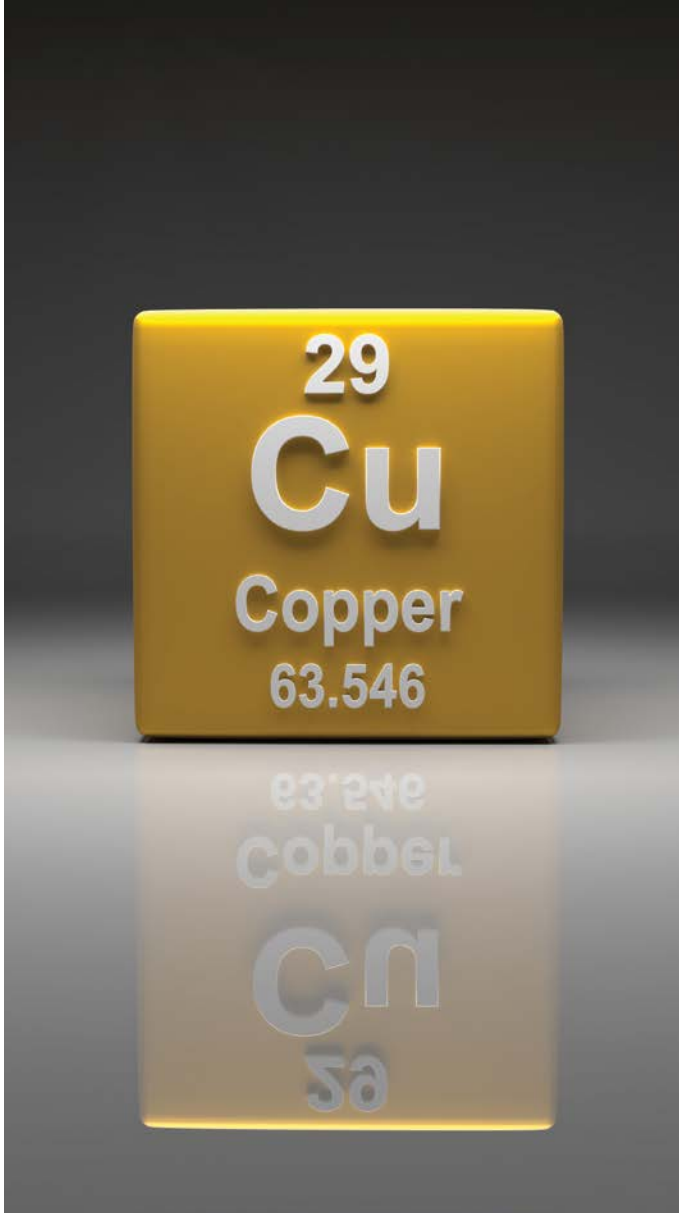
We provide a complete range of geochemical analysis and testing solutions to our global client base.

At MSALABS we understand that mining and exploration are dynamic and the pace and performance of these projects can be heavily reliant on assay results to guide management decisions on the next phase of work, in turn enabled by timely accurate data.

To assist our clients make decisions rapidly, we focus on delivering fast turnaround times (TAT) without compromising quality.

We deliver this through leading the adoption of the industry's most innovative technologies, investing in the highest quality, fastest and most efficient equipment, and designing laboratories that facilitate optimal performance.

We are dedicated to minerals testing for the exploration and mining industries, we are not dividing our time and resources with other analytical fields and we remain responsive and flexible to your needs – that means if something changes for you, we can respond and adjust our schedule to accommodate new requests in most cases.



Experienced Team & Expert Advice

Our team of industry experts take the time to understand your program to provide the best advice, across the entire sampling and analysis process.

If you are unsure on what analysis you need, we will work closely with you to understand what stage your project is at and what your specific goals are. This enables us to recommend a tailored suite of analytical methodologies to provide the data you need.

Our team's expertise also includes tailored laboratory design for optimal performance, construction and commissioning and ongoing assay laboratory management.

MSALABS is an innovative global assay services company offering a full range of geochemical laboratory services tailored to our client's needs.

Industry-leading turnaround times (TAT)

All metals, including Au, Ag, Cu, Li and Rare Earths

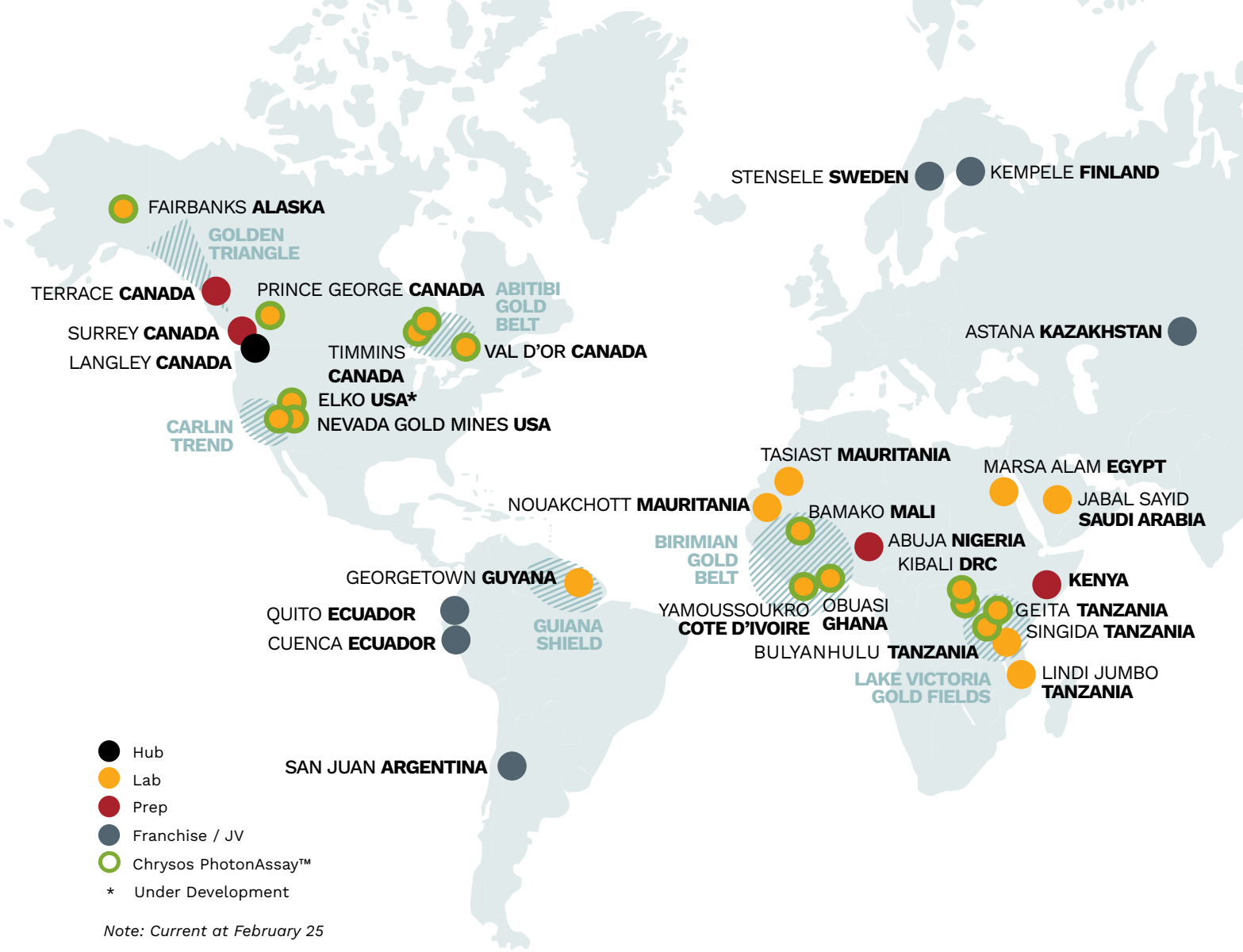
ISO 17025 accreditation for more than 70 methods

25+ laboratories globally (including franchise partners)

Largest PhotonAssay™ capability globally

Continued investment in equipment and technology to deliver the fastest Turnaround Times

---



Note: Current at February 25

Global Network

We have a rapidly growing network of laboratories in key mining regions around the world. They are strategically located to ensure our customers can access the latest assay technologies with shorter lead times and simplified logistics, and therefore lower costs.

Health, Safety & Environment Commitment

We are committed to operating sustainably and occupational health, safety and environmental performance is our first priority.

Through our unwavering focus on providing a safe work environment for our employees and ensuring our activities do not expose the environment or commmunities where we work to any harm, our customers can be confident they are working with a partner that places as much importance on these values as they do.

Community and Social Impact

We are committed to ensuring we act as a responsible corporate citizen and actively engage with the local communities where we operate. We strive to foster a positive and sustainable approach, contributing to various community projects and creating shared value. As such, we are accredited with the Social Responsibility and Compliance Initiative Management System, consistent with the requirements of SA8000:2014 and ISO 26000:2010 Guidelines.

MSALIMS Data on Demand

Our proprietary Laboratory Information Management System (MSALIMS) is a custom built, cloud based system with flexibility and data integrity designed into the solution.

MSALIMS allows for fast profiling and registration of samples, recording of catch weights and assay data and rapid QA/QC analysis and reporting. It provides our clients with 24/7 visibility of sample progress and analysis completion and reporting time frames are updated regularly, providing current information on when to expect results.

Data reports are available in most formats. They can be sent by email or can be retrieved via MSALIMS. Please enquire regarding the availability of your required format.

Quality Control

Our company maintains the highest quality standards and our quality management systems meets the guidelines of ISO17025 accreditation and ISO9001, ISO14001 and ISO45001 certification. Certificates are available for download from our website.

Our laboratories in Langley (TL- 736), Prince George (TL-1263), Timmins (TL-1214), Val d'Or (TL-1156) and Yamoussoukro (TL-1179) are accredited assay and geochemical laboratories under the ISO/IEC 17025 standard. All other laboratories operate to these guidelines. Internal and external audits and Management Reviews are conducted annually to ensure the effectiveness of the Quality Management System.

We use methods and procedures which are appropriate and documented for all tests within scope. These procedures include the handling, transport (where applicable), storage and preparation of samples to be tested and where appropriate, an estimation of the measurement uncertainty as well as statistical techniques for the analysis of test data.

Continuous improvements in methodologies and equipment operations are distributed to all laboratories as part of our system of globally aligned methods.

We also participate in scheduled proficiency testing schemes including Geostats, PTP-MAL, Rocklabs, OREAS and AMIS, that are executed by competent providers. The performance in the proficiency testing schemes allows for the evaluation of laboratory performance by an independent external party as well as comparison of relative performance using interlaboratory comparison.

Our analytical batches will include internal QCs (blanks, certified reference materials (CRM) and laboratory duplicates (replicates)) inserted into each batch of samples and are used to monitor laboratory hygiene, method accuracy and precision. Deviation from the acceptance criteria may necessitate the generation of repeat assays.

OUR SERVICES

We provide a comprehensive range of geochemical analysis services for exploration and mining companies, across all commodities.

Sample Preparation

Every step, from sample receipt until the laboratory begins the analysis, must be suitable for the specific needs of your project and must be completed with meticulous care to minimise errors.

Our expertise and state-of-the-art equipment ensures sample preparation that will provide results you can trust. Our team can also provide advice on the most suitable sample preparation methods to meet your needs and will work closely with you to understand exactly what answers you want and how best to get them.

Our sample preparation services cover a broad range of incoming sample types.

Geochemical Analysis

We provide a wide range of multi-element packages to ensure the most appropriate service for your project.

We'll ensure that each method presents a distinctive advantage for different sample matrices, target commodities and for the specific detection limits required.

Most importantly, we deliver a consistent, fast turn around time through investment in our capacity as well as the industry's latest technologies and equipment.

Precious Metals

We offer gold, platinum group and precious metal analysis suitable for grassroots exploration through to resource estimation and grade control. Our methods are suitable for ultra-trace to bullions, low and high grade material, through to precious metals forming a component of a trace element, finely disseminated grains or nuggets.

Specialty Assay

Our range of specialty assay services enable you to go deeper in the search for geochemical knowledge. Whether it be downstream concentrate analyses, or upstream low level multielement determinations, we have a solution to suit your needs. Our Geochemists are available to advise on the best methods to quantify your sample composition.

Metallurgical Services

For your high-grade materials, we have methods to accurately determine the level of metals of economic interest. Our chemists will advise the analytic technique best suited for your material.

PhotonAssay™

PhotonAssay™ is an innovative assay solution delivering faster, safer and more accurate gold, silver, copper and complementary element analysis.

Quantitiave results are available in minutes, providing near real time data for more efficient operational decision making.

We continue to lead the way in the adoption of this technology, supporting our customers with well placed facilities and easy access to the benefits PhotonAssay™ brings.

Laboratory Construction and Management

Our personnel have wide-ranging experience and involvement in the design, commissioning, and operation of commercial, near-mine and onsite laboratories around the world.

Our facilities are built to your specific site and project requirements. We will consider your space and individual technical requirements to deliver a customised laboratory design that will deliver the highest levels of safety and productivity.

We are also leaders in installing PhotonAssay™ units at brownfield mine site locations, and are the only company globally to provide this technology to on-site laboratories.

Franchises

Our unique franchise model allows us to bring our global capability quickly and cost effectively to a local level.

Our Franchise partners gain access to our global expertise, systems and solutions to deliver the right outcome for local customers in the regions in which they operate.

The network of Franchise partners is spread across the world and continues to grow, ensuring our customers are never too far from an MSALABS laboratory.

PHOTONASSAY™

PHOTONASSAY™ ANALYSIS

PhotonAssay™ is a groundbreaking x-ray assay technology providing more accurate analysis results in minutes, not days or weeks. It is an environmentally friendly alternative to fire assay on-site and in the laboratory.

PhotonAssay™ bombards samples with high-energy X-rays, causing excitation down to the nucleus level and allowing enhanced analysis of gold, silver, copper and complementary elements.

Typically, samples for PhotonAssay™ are crushed, 500g of the material is split into jars which are placed into the unit for analysis. Results can be available in as little as two minutes from entering the machine, with seven day turn-around-time (TAT) available to most clients.

With no lead based fluxes or furnaces required, PhotonAssay™ is both safer for our personnel and cleaner for the environment, with significantly reduced CO_2 produced and no chemical waste.

MSALABS led the way in adopting this groundbreaking technology, installing the first unit outside Australia, where it was developed. We now have more operating PhotonAssay™ laboratories globally than anyone else, meaning you can be confident we have capacity close to your operations, ready to deliver all the benefits of this revolutionary technology.

As a result of our extensive experience we have the skills and expertise to implement this technology quickly and the experience to ensure ongoing high quality management of your samples, including optimised sample preparation, automated jar cleaning and the fastest possible assay turnaround times for your gold, silver and copper* containing samples.

**Copper assay is only available in select locations and is not currently available in Canada, please contact your local MSALABS representative for more details.*

Measurable benefits over traditional fire assay analysis

	Time Per Sample[2]	Sample Size	CO_2 Per Sample	Hazardous Waste Per Sample	Energy Use Per Sample	Automation
Fire Assay	**3-4** Hours	**10-50** Grams	**0.91** Kg	**0.31** Kg	**1.3** kWh	✗
PhotonAssay™	**2-3** Mins	**250-650** Grams	**0.455** Kg	**0** Kg	**0.65** kWh	✓
Benefits	**80-90x** Times Faster	**13-25x** Larger Sample	**50%** Less Emissions	**ZERO** Hazardous Waste	**50%** Less Energy	**Automated Process**

1. *Comparison of PhotonAssay™ and Fire Assay per Frost & Sullivan industry report.*
2. *Fire Assay shown based on the minimum processing time. 24-hours is generally considered rapid turn around in practice.*
3. *Assumes same electricity source is used.*

PHOTONASSAY™

GOLD, SILVER AND COPPER

Fast TAT for gold and silver assay is available everywhere, with copper assay subject to further due diligence and not available in Canada currently.

Larger samples are analyzed, ensuring better repeatability and more representative results, especially for `nuggety` deposits.

DESCRIPTION		CODE
GOLD		
Gamma ray analysis of sample for gold by PhotonAssay™ instrument	0.015 - 350 350 - 5,000 5,000 - 10,000	CPA-Au1 CPA-Au12 CPA-Au13
Gamma ray analysis of samples for gold by PhotonAssay™ instrument (4 cycle)	0.015 - 350	CPA-Au2
SILVER		
Gamma ray analysis of sample for gold (optimized) & silver by PhotonAssay™ instrument		CPA-AuAg1
Gamma ray analysis of sample for gold & silver (optimized) by PhotonAssay™ instrument		CPA-AgAu1
COPPER		
Copper		CPA-Cu1

Note 1: Copper assay is only available in select locations, please contact your local MSALABS representative for more details.

LABORATORY DESIGN AND CONSTRUCTION SERVICES

ON-SITE LABORATORIES

MSALABS provides both standardised and fully customizable laboratory solutions.

Our broad experience enables us to offer everything from design services to full turnkey laboratory delivery, with optimized configurations to meet your needs. As a rapidly growing global laboratory service provider, our highly optimized commercial laboratories service a range of customers from large mining conglomerates to junior exploration companies, engineering firms, universities, geological surveyors, and government departments and consultants.

We work to build partnerships with our clients, understanding their needs and tailoring our technical solutions accordingly. On this basis we continue to grow with pace, working closely with our customers around the world to deliver the latest technologies efficiently but most importantly, safely.

Our in-house experts bring decades of experience delivering and managing geochemistry laboratories, and we make this capability available to our customers through a range of services:

- Design of assay laboratories
- Laboratory construction and project management
- Project planning and scheduling
  Value engineering – reducing operating costs for existing facilities
- Laboratory facility upgrades
- Equipment finalization
- Installation and commissioning services
- Management of assay laboratories

At June 2024, our expert team has delivered 14 laboratories in 36 months, with zero harm, within budget and on-time.

Global Laboratory Project Delivery

We have successfully delivered a number of laboratories capable of providing comprehensive geochemistry services and PhotonAssay™ analysis on site for some of the world's largest mining companies, as well as commercial MSALABS facilities.

Bulyanhulu Gold Mine,
Tanzania
Client: Barrick
Established: 2021

The Bulyanhulu laboratory houses a large-scale geochemistry facility, including sample preparation, wet chemistry and a PhotonAssay™ unit. The laboratory was delivered ahead of schedule and with zero safety incidents.

The installation of the PhotonAssay™ unit at Bulyanhulu was the first international installation outside Australia, where the technology originated.

Val-d'Or Commercial Laboratory,
Canada
MSALABS laboratory
Established: 2022

The Val-d'Or laboratory services the substantial Quebec mining region in Canada. With it's proximity to the Abitibi gold belt, as well as the growth of base and transition metals including lithium, it provides sample preparation as well as being the location of the region's first PhotonAssay™ unit.

With operations spanning Africa and Northern Canada, we are experienced in managing the challenges of extreme climatic conditions.

Kibali Gold Mine,
Democratic Republic of Congo
Client: Barrick
Established: 2023

The Kibali Gold Mine laboratory is capable of processing over 45,000 gold samples a month and includes capability to deliver multiple complex methods in a modern setting with the highest standards of safety.







SAMPLE PREPARATION

SAMPLE PREPARATION

Sample preparation includes all steps from sample receipt until delivery to the assay department.

The purpose of sample preparation is to ensure that the laboratory processes a pulp representative of the whole sample. Sample preparation needs vary according to the project and the sample matrix. If you would like a specific sample preparation method, please let us know and we can tailor a package to your needs.

ROCKS AND DRILL CORE PACKAGES

Preparation of rock samples and drill core require meticulous care to produce a homogeneous sub-sample for analysis. MSALABS's Quality System is as comprehensive in Sample Preparation as in any other area of our business.

DESCRIPTION	CODE
Dry, crush to 2mm, split 250g sub-sample and pulverize to 85% passing 75µm	PRP-910
Dry, crush to 2mm, split 500g sub-sample and pulverize to 85% passing 75µm	PRP-915
Dry, crush to 2mm, split 1000g sub-sample and pulverize to 85% passing 75µm	PRP-920
Surcharge for samples > 1kg, per kg	PRP-950

* Note that entire sample is crushed,

SOIL AND SEDIMENT

Soil and sediment samples are dried and then screened to the desired mesh size. The undersized (-) fraction is analyzed and the oversized (+) fraction is discarded unless otherwise specified.

DESCRIPTION	CODE
Dry, screen 1 kg to 80 mesh, discard plus fraction	PRP-758
Dry, screen 1 kg to 230 mesh, discard plus fraction	PRP-759
Extra drying for excessively wet samples, per 500g	DRI-100
Screen at other sieve size	PSC-999
Surcharge for soils >1kg, per kg (80m)	PSC-101
Surcharge for soils >1kg, per kg (230m)	PSC-102
Save all soil reject	PSC-110

OTHER INDIVIDUAL PREPARATION METHODS

DRYING

DESCRIPTION	CODE
Drying at 60°C	DRI-060
Drying at 90°	DRI-090
Extra drying time for excessively wet samples, per kg	DRI-100
Air drying of samples	DRI-200
Drying to customer specification	DRI-300

CRUSHING

DESCRIPTION	CODE
Crush to 70% passing 2mm	CRU-220
Dry, crush to 70% passing 2mm	CRU-221
Crush to 90% passing 2mm	CRU-240
Dry, crush to 90% passing 2mm	CRU-241
Crush to 70% passing 6mm (1/4")	CRU-260
Dry, crush to 70% passing 6mm (¼")	CRU-261
Surcharge for samples >1kg, per kg	CRU-200
Crush to customer specification	CRU-999

SPLITTING

DESCRIPTION	CODE
Split pulp for various uses (Riffle Split), per kg	SPL-400
Split 250g crushed material (Riffle Split)	SPL-410
Split 250g crushed material (Rotary Split)	SPL-415
Split 1000g crushed material (Riffle Split)	SPL-420
Split 1000g crushed material (Rotary Split	SPL-425
Split 500g crushed material (Riffle Split)	SPL-430
Split 500g crushed material (Rotary Split)	SPL-435

PULVERIZING

DESCRIPTION	CODE
Pulverize 250g to 85% passing 75µm	PPU-510
Pulverize 500g to 85% passing 75µm	PPU-520
Pulverize 1000g to 85% passing 75µm	PPU-530
Pulverize 500g to 85% passing 106µm	PPU-620
Pulverize 1000g to 85% passing 106µm	PPU-630

MISCELLANEOUS

DESCRIPTION	CODE
Wash crusher with barren material between each sample	PWA-200
Wash pulverizer with barren material between each sample	PWA-500
Homogenizing and pulverizing composite, per 250g	PPU-560
Homogenizing pulp by mat rolling	PRO-100
Homogenizing pulp by light pulverizing	PRO-200

SAMPLING SUPPLIES

DESCRIPTION	PACK QTY
Shipping Sacks (Rice Bags)	10
Plastic Bags, 6 mil 8” x 13”	100
Plastic Bags, 6 mil 12” x 18”	100
Tin-Tie Bags	1,000
Cable Ties, 7”	100
Assay Tags, 50 tags/booklet	Per booklet

ADMINISTRATION FEES

DESCRIPTION	CODE
Batch charge for shipments less than 20 samples	ADM-100
Single charge for each batch of samples submitted	ADM-300
Log sample received as pulp	PLG-100
Sample pick up service available at any MSALABS	PIC-100

Please contact us for more information.

SAMPLE STORAGE AND DISPOSAL

All pulps and rejects will be stored at our facility free of charge for 90 days. The free storage period starts on the day that the Test Report is released.

At the end of this free storage period, the samples will either continue to be stored, disposed of or returned to you. Please inform us if you would like your samples returned to you sooner (that is, as soon as analysis is complete).

For samples to be returned, our staff will contact you to arrange shipment. If there is any change of sample storage information, please contact us within the 90-day free period.

DESCRIPTION	CODE
Handling and retrieval of pulp or reject from storage, per hour	STO-100
Storage of reject after 90-day free period, per sample/month	STO-200
Storage of pulp after 90-day free period, per sample/month	STO-300
Reject disposition, per sample (≤ 3 kg)	DIS-100
Reject disposition, per sample (>3kg, per kg)	DIS-101
Pulp disposition, per sample	DIS-200
Material disposal	MDIS-300
Heat treatment and disposal of International soils	DIS-400
Special handling, per hour	HAN-200
Return shipment of reject / pulp	DIS-500
Environmental Handling Fee	ENV-100

PRECIOUS METALS ANALYSIS

PRECIOUS METALS

In conventional fire assay, sample pulp is mixed with a combination of chemical reagents. The mixture is heated at high temperature resulting in the formation of a lead button and slag.

The lead button which contains the precious metals is cupelled at high temperature. The lead is absorbed by the cupel and leaves behind a bead that contains the precious metals. The bead is acid digested and analyzed by instrumental or gravimetric method. In order to optimize the precious metals recovery, the lab may reduce the sample weight at its discretion.

GOLD

DESCRIPTION	DETECTION RANGE (PPM)	FUSION SIZE	CODE
TRACE LEVEL			
Fire Assay/AAS finish	0.005 – 10	30g	FAS-111
		50g	FAS-121
Fire Assay/ICP-ES finish	0.002 – 10	30g	FAS-114
		50g	FAS-124
ORE GRADE			
Fire Assay/AAS finish	0.01 – 100	30g	FAS-211
		50g	FAS-221
Fire Assay/ICP-ES finish	0.01 – 100	30g	FAS-214
		50g	FAS-224
GRAVIMETRIC			
Fire Assay/Gravimetric finish	0.9 - 10,000	30g	FAS-415
		50g	FAS-425
PHOTONASSAY™			
Gamma ray analysis of sample for gold by PhotonAssay™ instrument	0.015 - 350		CPA-Au1
Gamma ray analysis of samples for gold by PhotonAssay™ instrument (4 cycle)	0.015 - 350		CPA-Au2

SILVER

DESCRIPTION	DETECTION RANGE (PPM)	FUSION SIZE	CODE
TRACE LEVEL			
Aqua regia digestion/ICP-ES finish	0.2 – 100	N/A	ICA-5Ag
Note: See the Multi-Element Packages section of the guide for methods that include Ag in the suite of metals reported.			
ORE GRADE			
Aqua regia digestion/ICP-ES finish	1 — 1,500	N/A	ICA-6Ag
Note: See the Multi-Element Packages section of the guide for methods that include Ag in the suite of metals reported.			
GRAVIMETRIC			
Fire Assay/Gravimetric finish	50 — 10,000	30g	FAS-418
		50g	FAS-428
PHOTONASSAY™			
Gamma ray analysis of sample for gold (optimized) & silver by PhotonAssay™ instrument			CPA-AuAg1
Gamma ray analysis of sample for gold & silver (optimized) by PhotonAssay™ instrument			CPA-AgAu1

BULLION

DESCRIPTION	DETECTION RANGE (PPM)	CODE
Gold	0.01 – 1,000	FAS-501
Silver	0.01 – 1,000	FAS-502

GOLD AND SILVER

DESCRIPTION	DETECTION RANGE (PPM)		FUSION SIZE	CODE
TRACE LEVEL				
Gold – Fire Assay/AAS finish Silver – Aqua regia/ICP-ES finish	Au: 0.005 – 10	Ag: 0.2 – 100	30g	AuAg-12
			50g	AuAg-22
GRAVIMETRIC				
Fire Assay/Gravimetric finish	Au: 0.9 - 10,000	Ag: 50 – 10,000	30g	FAS-413
			50g	FAS-423

GOLD, PLATINUM AND PALLADIUM

DESCRIPTION	DETECTION RANGE (PPM)		FUSION SIZE	CODE
TRACE LEVEL				
Fire Assay/ICP-ES finish	Au, Pd: 0.002 – 10	Pt: 0.005 – 10	30g	FAS-113
			50g	FAS-123
ORE GRADE				
Fire Assay/ICP-ES finish	Au, Pt, Pd: 0.01-100		30g	FAS-213
			50g	FAS-223

OSMIUM, RHODIUM, RUTHENIUM AND IRIDIUM

Contact us for more information.

DESCRIPTION	DETECTION RANGE (PPM)	FUSION SIZE	CODE
TRACE LEVEL			
NiS Fire Assay/INAA	Matrix dependent	On request	FAS-611

METALLIC SCREENING – GOLD

When samples are known to or suspected to contain metallic grains, it is preferable to analyze by metallic screening. 500g or 1kg of sample will be screened to 106µm. The entire plus (+) fraction is assayed while the minus (-) fraction is assayed in duplicate. Both fractions use fire assay techniques with gravimetric or instrumental finish.

Other screen sizes are also available upon request.

DESCRIPTION	DETECTION RANGE (PPM)	FUSION SIZE	CODE
500G SCREENED			
Plus fraction and duplicate minus fractions	0.9 - 10,000	30g	MSC-530
		50g	MSC-550
1000G SCREENED			
Plus fraction and duplicate minus fractions	0.9 - 10,000	30g	MSC-130
		50g	MSC-150

CONCENTRATE

DESCRIPTION	DETECTION RANGE (PPM)	CODE
Gold	5 – 800,000	CON-9Au
Silver	5 – 800,000	CON-9Ag
Platinum	5 – 800,000	CON-9Pt
Palladium	5 – 800,000	CON-9Pd

ORE GRADE

AQUA REGIA DIGESTION

MULTI-ELEMENT ICP-ES (33 ELEMENTS)

DETECTION RANGE (% UNLESS OTHERWISE NOTED)						CODE
Ag	1 — 1,500ppm	Fe	0.05 - 50	Pb	0.001 – 5	True strength aqua regia
Al	0.05 - 50	Ga	0.005 – 5	S	0.05 – 10	ICP-140
As	0.001 – 10	Hg	0.001 – 5	Sb	0.001 – 5	
Ba	0.005 - 5	K	0.05 – 50	Sc	0.001 – 5	
Be	0.001 – 5	La	0.005 - 5	Sr	0.001 – 5	
Bi	0.001 – 5	Mg	0.05 – 50	Ti	0.05 – 50	
Ca	0.05 – 50	Mn	0.01 – 25	Tl	0.005 – 5	
Cd	0.001 – 1	Mo	0.001 – 5	V	0.001 – 5	
Co	0.001 – 5	Na	0.05 – 50	W	0.005 – 5	
Cr	0.001 – 5	Ni	0.001 – 5	Zn	0.001 – 15	
Cu	0.001 – 10	P	0.005 – 25	Zr	0.001 – 2	
Any one or more elements available upon request						ICA-6xx*

*Insert element symbol for (xx).

4-ACID DIGESTION

MULTI-ELEMENT ICP-ES (30 ELEMENTS)

DETECTION RANGE (% UNLESS OTHERWISE NOTED)						CODE
Ag	1 – 1,000 ppm	Cu	0.001 – 40	P	0.01 – 10	ICP-240
Al	0.05 – 30	Fe	0.05 – 50	Pb	0.01 – 20	
As	0.005 – 10	K	0.1 – 30	S	0.05 – 10	
Ba	0.005 – 5	La	0.005 – 5	Sb	0.005 – 5	
Be	0.001 – 1	Li	0.005 – 5	Sr	0.01 – 10	
Bi	0.005 – 5	Mg	0.05 – 50	Ti	0.05 – 30	
Ca	0.05 – 50	Mn	0.01 – 10	Tl	0.005 – 5	
Cd	0.001 – 1	Mo	0.001 – 5	V	0.001 – 10	
Co	0.001 – 5	Na	0.05 – 30	W	0.01 – 5	
Cr	0.001 – 10	Ni	0.001 – 10	Zn	0.01 – 40	
Any one or more elements available upon request						ICF-6xx*

*Insert element symbol for (xx).

PEROXIDE FUSION WITH ICP-ES FINISH (18 ELEMENTS)

DETECTION RANGE (%)						CODE
Al	0.01 – 50	Fe	0.05 – 70	Pb	0.01 – 30	PER-700
As	0.01 – 10	K	0.1 – 30	S	0.01 – 60	
Ca	0.05 – 50	Li	0.01 – 30	Si	0.1 – 50	
Co	0.002 – 30	Mg	0.01 – 30	Sn	0.01 – 30	
Cr	0.01 – 30	Mn	0.01 – 50	Ti	0.01 – 30	
Cu	0.005 – 30	Ni	0.005 – 30	Zn	0.01 – 30	
Mo & W available upon request						PER-7xx*

*Insert element symbol for xx.

FUSION AND ICP-ES / ICP-MS FINISH

SINGLE ELEMENTS

DESCRIPTION	DETECTION RANGE (%)	CODE
B	0.005 – 10	PER-7xx*

*Insert element symbol for xx.

GEOCHEMICAL ANALYSIS

GEOCHEMICAL ANALYSIS

Our team will provide advice on the most appropriate method for your project, to ensure your decisions are based on accurate data.

Our range of services will meet project needs from greenfields and brownfields exploration through to ore body definition, grade control and concentrate analysis. Our multi-element packages ensure that each method presents an optimal solution for different sample matrices, target commodity and detection limits.

Please note some detection limits may vary depending on the sample matrix.

AQUA REGIA DIGESTION

MSALABS offers various types of Aqua Regia digestion: a true strength mixture of hydrochloric and nitric acids and dilute mixtures (equal portion) of hydrochloric, nitric, and deionized water. Aqua Regia acts as an oxidizing agent to dissolve most oxide, sulfide and carbonate minerals and is an excellent trace level exploration tool.

This is a partial digestion ideal for greenfields exploration since more resistant minerals including silicates are not significantly digested. By leaving the matrix undissolved, mobile pathfinder elements produce greater anomaly to background contrast enhancing confidence during target generation.

MULTI-ELEMENT ICP-MS AND ICP-ES (39 ELEMENTS)

TRACE LEVEL – AQUA REGIA							
DETECTION RANGE (PPM UNLESS OTHERWISE NOTED)						CODE	
Ag	0.05 – 100	Ga	0.1 - 10,000	Sb	0.05 - 10,000	True strength aqua regia	
Al	0.01% - 25%	Hg	0.005 - 10,000	Sc	0.1 - 10,000	IMS-127	0.5g
As	0.1 - 10,000	K	0.01% - 10%	Se	0.2 - 1,000	IMS-128	20g
Au	0.5 ppb - 25	La	0.5 - 10,000	Sr	0.5 - 10,000	IMS-129	40g
B	10 - 10,000	Mg	0.01% - 25%	Te	0.05 – 500		
Ba	10 - 10,000	Mn	5 - 50,000	Th	0.2 - 10,000		
Bi	0.01 - 10,000	Mo	0.05 - 10,000	Ti	0.01% - 10%	Dilute aqua regia	
Ca	0.01% - 25%	Na	0.01% - 10%	Tl	0.02 - 10,000	IMS-116	0.5g
Cd	0.05 - 1,000	Ni	0.2 - 10,000	U	0.05 - 10,000	IMS-117	20g
Co	0.1 - 10,000	P	10 - 10,000	V	1 - 10,000	IMS-118	40g
Cr	1 - 10,000	Pb	0.2 - 10,000	W	0.05 - 10,000		
Cu	0.2 - 10,000	Re	0.005 – 50	Y	0.5 – 500		
Fe	0.01% – 50%	S	0.01% - 10%	Zn	2 - 10,000		

MULTI-ELEMENT ICP-MS AND ICP-ES (51 ELEMENTS)

ULTRA TRACE LEVEL – AQUA REGIA							
DETECTION RANGE (PPM UNLESS OTHERWISE NOTED)						CODE	
Ag	0.01 – 100	Hf	0.02 – 500	Sc	0.1 – 10,000	True strength aqua regia	
Al	0.01% - 25%	Hg	0.005 – 10,000	Se	0.2 – 1,000	IMS-130	0.5g
As	0.1 – 10,000	In	0.005 – 500	Sn	0.2 – 500	IMS-131	20g
Au*1	0.5ppb – 25	K	0.01% - 10%	Sr	0.2 – 10,000	IMS-132	40g
B	10 – 10,000	La	0.2 – 10,000	Ta	0.01 – 500		
Ba	10 – 10,000	Li	0.1 – 10,000	Te	0.01 – 500	Dilute aqua regia	
Be	0.05 – 1,000	Mg	0.01% - 25%	Th	0.2 – 10,000	IMS-110	0.5g
Bi	0.01 – 10,000	Mn	5 – 50,000	Ti	0.01% – 10%	IMS-111	20g
Ca	0.01% - 25%	Mo	0.05 – 10,000	Tl	0.02 – 10,000	IMS-112	40g
Cd	0.01 – 1,000	Na	0.01% - 10%	U	0.05 – 10,000		
Ce	0.02 – 500	Nb	0.05 – 500	V	1 – 10,000		
Co	0.1 – 10,000	Ni	0.2 – 10,000	W	0.05 – 10,000		
Cr	1 – 10,000	P	10 – 10,000	Y	0.05 – 500		
Cs	0.05 – 500	Pb	0.2 – 10,000	Zn	1 – 10,000		
Cu	0.2 – 10,000	Rb	0.1 – 10,000	Zr	0.5 – 500		
Fe	0.01% - 50%	Re	0.001 – 50				
Ga	0.05 – 10,000	S	0.01% - 10%				
Ge	0.05 – 500	Sb	0.05 – 10,000				

Any one or more elements available upon request.

True strength aqua regia	IMA-5xx*2 (0.5g)	IMA-2xx*2 (20g)	IMA-4xx*2 (40g)
Dilute aqua regia	IMD-5xx*2 (0.5g)	IMD-2xx*2 (20g)	IMD-4xx*2 (40g)

Note 1: Gold is semi-quantitative due to the small sample size (0.5g), sample matrix and acid strength.

Note 2: Platinum, palladium, REE's available upon request.

*Insert element symbol for (xx).

MULTI-ELEMENT ICP-ES (35 ELEMENTS)

BASIC LEVEL -AQUA REGIA						
DETECTION RANGE (PPM UNLESS OTHERWISE NOTED)						CODE
Ag	0.2 – 100	Fe	0.01% – 50%	S	0.01% – 10%	True strength aqua regia
Al	0.01% - 25%	Ga	10 – 10,000	Sb	2 – 10,000	ICP-130
As	2 – 10,000	Hg	1 – 10,000	Sc	2 – 10,000	
B	10 – 10,000	K	0.01% - 10%	Sr	1 – 10,000	
Ba	10 – 10,000	La	10 – 10,000	Th	8 – 2,000	
Be	0.5 – 1,000	Mg	0.01% - 25%	Ti	0.01% – 10%	
Bi	2 – 10,000	Mn	5 – 50,000	Tl	10 – 10,000	
Ca	0.01% - 25%	Mo	1 – 10,000	V	1 – 10,000	
Cd	0.5 – 2,000	Na	0.01% - 10%	W	10 – 10,000	
Co	1 – 10,000	Ni	1 – 10,000	Zn	1 – 10,000	
Cr	1 – 10,000	P	10 – 10,000	Zr	5 – 2,000	
Cu	1 – 10,000	Pb	2 – 10,000			
ICP-130 Multi-element package + Hg by ICP-MS					0.005 – 10,000	ICP-135
Any one or more elements available upon request						ICA-5xx*

*Insert element symbol for (xx).

4-ACID DIGESTION

4-Acid or 'near total' digestion uses a combination of hydrochloric, nitric, perchloric and hydrofluoric acids. Only the most highly resistant minerals will not be dissolved. Mercury is volatilized in this type of digestion; however, it can be added by using aqua regia digestion at an additional cost.

Minimum weight requirement is 1g pulp.

MULTI-ELEMENT ICP-MS AND ICP-ES (48 ELEMENTS)

ULTRA TRACE LEVEL -4-ACID

DETECTION RANGE (PPM UNLESS OTHERWISE NOTED)						CODE
Ag	0.01 – 100	Hf	0.1 – 500	Sb	0.5 – 10,000	IMS-230
Al	0.01% – 50%	In	0.005 – 500	Sc	0.1 – 10,000	
As	0.2 – 10,000	K	0.01% – 10%	Se	1 – 1,000	
Ba	10 – 10,000	La	0.5 – 10,000	Sn	0.2 – 500	
Be	0.05 – 1,000	Li	0.2 – 10,000	Sr	0.2 – 10,000	
Bi	0.01 – 10,000	Mg	0.01% – 50%	Ta	0.05 – 100	
Ca	0.01% – 50%	Mn	5 – 100,000	Te	0.05 – 500	
Cd	0.02 – 1,000	Mo	0.05 – 10,000	Th	0.2 – 10,000	
Ce	0.02 – 500	Na	0.01% – 10%	Ti	0.01% – 10%	
Co	0.1 – 10,000	Nb	0.1 – 500	Tl	0 02 – 10,000	
Cr	1 – 10,000	Ni	0.2 – 10,000	U	0.1 – 10,000	
Cs	0.05 – 500	P	10 – 10,000	V	1 – 10,000	
Cu	0.2 – 10,000	Pb	0.5 – 10,000	W	0.1 – 10,000	
Fe	0.01% - 50%	Rb	0.1 – 10,000	Y	0.1 – 500	
Ga	0.05 – 10,000	Re	0.002 – 50	Zn	2 – 10,000	
Ge	0.05 – 500	S	0.01% – 10%	Zr	0.5 – 500	
IMS 230 Multi-element package + Hg by ICP-MS					0.005 – 10,000	IMS-235
Any one or more elements available upon request						IMF-5xx*

Note 1: REE's available upon request.

*Insert element symbol (xx).

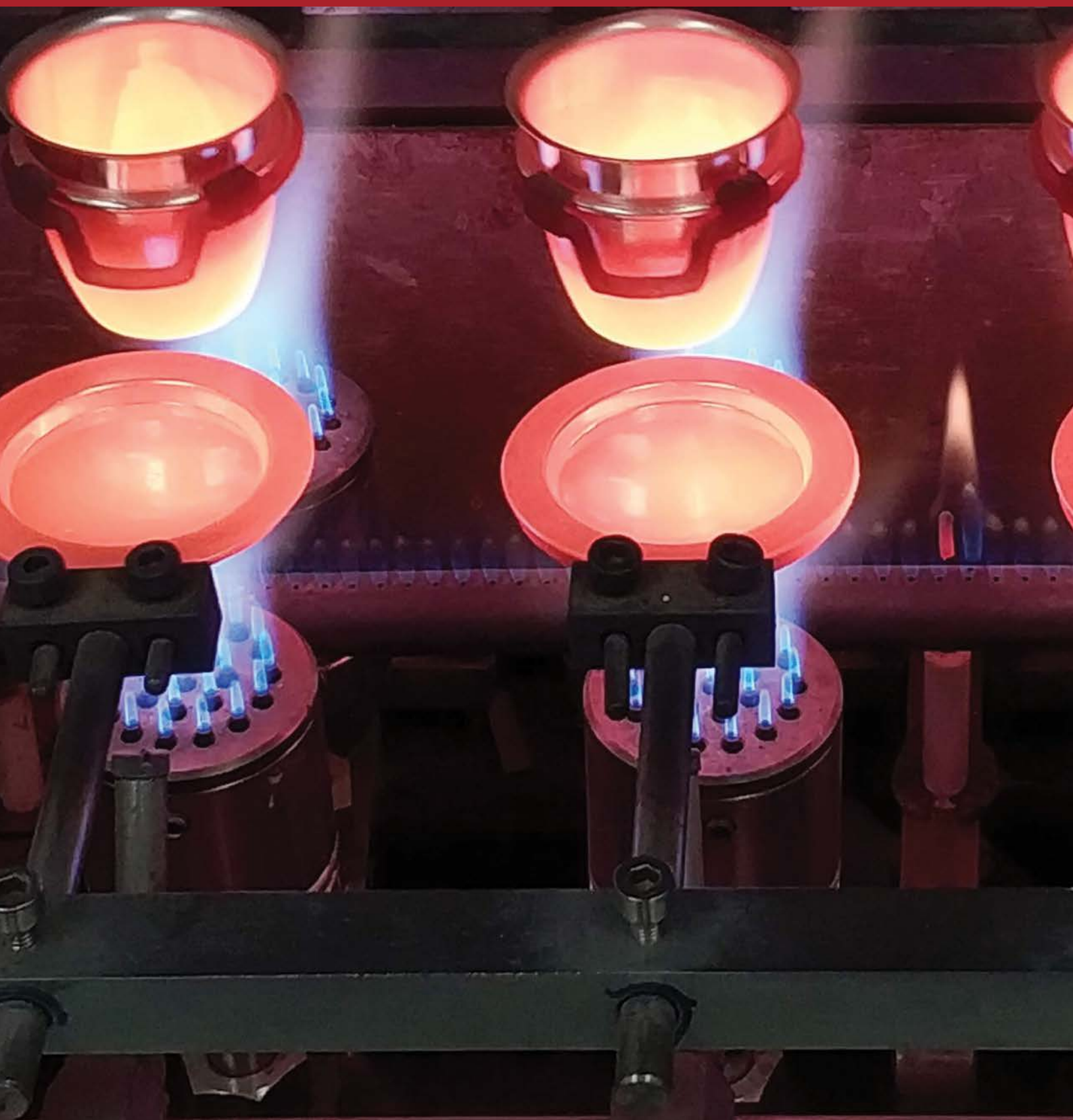
MULTI-ELEMENT ICP-ES (34 ELEMENTS)

BASIC LEVEL -4-ACID

DETECTION RANGE (PPM UNLESS OTHERWISE NOTED)						CODE
Ag	0.5 – 100	Ga	10 – 10,000	S	0.01% – 10%	ICP-230
Al	0.01% – 50%	K	0.01% – 10%	Sb	5 – 10,000	
As	5 – 10,000	La	10 – 10,000	Sc	2 – 10,000	
Ba	10 – 10,000	Li	10 – 10,000	Sr	1 – 10,000	
Be	0.5 – 1,000	Mg	0.01% – 50%	Th	8 –10,000	
Bi	2 – 10,000	Mn	5 – 100,000	Ti	0.01% – 10%	
Ca	0.01% – 50%	Mo	1 – 10,000	Tl	10 – 10,000	
Cd	0.5 – 1,000	Na	0.01% – 10%	V	1 – 10,000	
Co	1 – 10,000	Ni	1 – 10,000	W	10 – 10,000	
Cr	1 – 10,000	P	10 – 10,000	Zn	2 – 10,000	
Cu	1 – 10,000	Pb	2 – 10,000	Zr	5 – 2,000	
Fe	0.01% – 50%					
ICP-230 Multi-element package + Hg by ICP-MS					0.005 – 10,000	ICP 235
Any one or more elements available upon request						ICF-5xx*

*Insert element symbol (xx).

LITHOGEOCHEMISTRY



LITHOGEOCHEMISTRY

WHOLE ROCK ANALYSIS – LITHIUM BORATE FUSION AND ICP-ES FINISH (13 PARAMETERS + LOI)

DETECTION RANGE (%)						CODE
Al_2O_3	0.01 – 100	K_2O	0.01 – 100	SiO_2	0.01 – 100	WRA-310
BaO	0.01 – 100	MgO	0.01 – 100	SrO	0.01 – 100	
CaO	0.01 – 100	MnO	0.01 – 100	TiO_2	0.01 – 100	
Cr_2O_3	0.01 – 100	Na_2O	0.01 – 100	LOI	0.01 – 100	
Fe_2O_3	0.01 – 100	P_2O_5	0.01 – 100			
WRA-310 + C&S		C	0.01 – 50	S	0.01 – 50	WRA-311
Any one or more elements available upon request						WRA-3xx*

*Insert element symbol for xx.

WHOLE ROCK ANALYSIS – LITHIUM BORATE FUSION & XRF FINISH (14 PARAMETERS + LOI)

DETECTION RANGE (%)						CODE
Al_2O_3	0.01 – 100	K_2O	0.01 – 15	SiO_2	0.01 – 100	WRX-310
BaO	0.01 – 66	MgO	0.01 – 45	SO_3	0.01 – 30	
CaO	0.01 – 55	MnO	0.01 – 40	SrO	0.01 – 1.5	
Cr_2O_3	0.01 – 10	Na_2O	0.01 – 10	TiO_2	0.01 – 30	
Fe_2O_3	0.01 – 100	P_2O_5	0.01 – 45	LOI	0.01 – 100	
WRX-310 + C&S		C	0.01 – 50	S	0.01 – 50	WRX-311
Any one or more elements available upon request						WRX-3xx*

* Insert element symbol for (xx).

LOSS ON IGNITION (LOI) ANALYSIS

DESCRIPTION	DETECTION RANGE (%)	CODE
Loss on Ignition @ 550°C	0.01 – 100	LOI-550
Loss on Ignition @ 1000°C	0.01 – 100	LOI-1000

REFRACTORIES AND RARE EARTH ELEMENTS (REE'S) LITHIUM BORATE FUSION AND ICP-MS

DETECTION RANGE (PPM)						CODE
Ba	0.5 – 10,000	Ho	0.01 – 1,000	Ta	0.1 – 2,500	IMS-300
Ce	0.1 – 10,000	La	0.1 – 10,000	Tb	0.01 – 1,000	
Cr	10 – 10,000	Lu	0.01 – 1,000	Th	0.05 – 1,000	
Cs	0.01 – 10,000	Nb	0.1 – 2,500	Tm	0.01 – 1,000	
Dy	0.05 – 1,000	Nd	0.1 – 10,000	U	0.05 – 1,000	
Er	0.03 – 1,000	Pr	0.03 – 1,000	V	10 – 10,000	
Eu	0.03 – 1,000	Rb	0.2 – 10,000	W	1 – 10,000	
Ga	0.2 – 1,000	Sm	0.03 – 1,000	Y	0.5 – 10,000	
Gd	0.05 – 1,000	Sn	5 – 10,000	Yb	0.03 – 1,000	
Hf	0.2 – 10,000	Sr	0.1 – 10,000	Zr	2 – 10,000	

PEROXIDE FUSION ICP-ES AND ICP-MS

DETECTION RANGE (PPM UNLESS OTHERWISE NOTED)						CODE
Ag	10 - 12,500	Ho	0.01 - 25,000	Si	0.1% – 50%	IMS-700
Al	0.05% - 25%	In	0.3 - 25,000	Sm	0.04 - 25,000	
As	10 - 25,000	K	0.05% – 25%	Sn	5 - 25,000	
Ba	8 - 25,000	La	0.08 - 25,000	Sr	20 - 25,000	
Be	2 - 25,000	Li	2 - 25,000	Ta	3 - 25,000	
Bi	0.2 - 25,000	Lu	0.05 - 25,000	Tb	0.01 - 25,000	
Ca	0.1% - 25%	Mg	0.05% – 25%	Te	5 - 25,000	
Cd	1 - 25,000	Mn	10 - 25,000	Th	1 - 25,000	
Ce	0.2 - 25,000	Mo	2 - 25,000	Ti	0.005% – 25%	
Co	1 - 25,000	Nb	5 - 25,000	Tl	0.02 - 25,000	
Cs	0.2 - 25,000	Nd	0.2 - 25,000	Tm	0.01 - 25,000	
Cu	20 - 25,000	Ni	10 - 25,000	U	1 - 25,000	
Dy	0.03- 25,000	Pb	2 - 25,000	V	10 - 25,000	
Er	0.02 - 25,000	Pr	0.05 - 25,000	W	5 - 25,000	
Eu	0.05 - 25,000	Rb	10 - 25,000	Y	1 - 25,000	
Fe	0.05% – 25%	Re	0.01 - 25,000	Yb	0.02 - 25,000	
Ga	5 - 25,000	S	0.05% – 25%	Zn	10 - 25,000	
Gd	3 - 25,000	Sb	4 - 25,000			
Ge	2 - 25,000	Se	10 - 25,000			

COMPLETE WHOLE ROCK PACKAGE

DESCRIPTION	CODE
Whole Rock + C&S + Refractories and REE's	WRA-330
Complete Package: Whole Rock + C&S (WRA-311)	WRA-360
+ Refractories and REE's (IMS-300)	
+ Aqua regia digestion add-on	
+ 4-acid digestion add-on	

IMS-130 ADD ON

AQUA REGIA DIGESTION AND ICP-MS AND ICP-ES

DESCRIPTION	DETECTION RANGE (PPM)
As	0.1 - 10,000
Au	0.5 ppb - 25
Bi	0.01 - 10,000
Hg	0.005 - 10,000
Sb	0.05 - 10,000
Se	0.2 - 1,000
Tl	0.02 - 10,000

IMS-230 ADD ON

4-ACID DIGESTION AND ICP-MS AND ICP-ES

DESCRIPTION	DETECTION RANGE (PPM)
Ag	0.1 - 100
Cd	0.02 - 1,000
Cu	0.2 - 10,000
Mo	0.05 - 10,000
Ni	0.2 - 10,000
Pb	0.5 - 10,000
Zn	2 - 10,000

RESISTIVE MINERALS – LITHIUM BORATE FUSION AND XRF FINISH

DETECTION RANGE (%)						CODE
Ba	0.01 – 40	Sb	0.01 – 45	U	0.01 – 13	
Ga	0.01 – 10	Sn	0.01 – 55	W	0.01 – 50	
Ge	0.01 – 10	Ta	0.01 – 45	Zr	0.01 – 50	
Nb	0.01 – 10	Th	0.01 – 13			
Any one element						WRX-4xx*

* Insert element symbol for (xx).

Additional element available upon request.

RARE EARTH ELEMENTS (REE'S) – LITHIUM BORATE FUSION AND XRF FINISH

DETECTION RANGE (%)						CODE
CeO_2	0.1 — 50	Ho_2O_2	0.1 – 10	Sm_2O_3	0.1 – 10	WRX-500
Dy_2O_3	0.1 — 10	La_2O_3	0.1 – 50	Tb_4O_7	0.1 – 10	
Er_2O_3	0.1 — 10	Lu_2O_3	0.1 – 10	Tm_2O_3	0.1 – 10	
Eu_2O_3	0.1 — 10	Nd_2O_3	0.1 – 10	Y_2O_3	0.1 – 10	
Gd_2O_3	0.1 — 10	Pr_6O_{11}	0.1 – 10	Yb_2O_3	0.1 – 10	
Any one element						WRX-5xx*

* Insert element symbol for (xx).

Please contact your local MSALABS representative for more details.

IRON ORE - LITHIUM BORATE FUSION AND XRF FINISH

DETECTION RANGE (%)						CODE
Al_2O_3	0.01 – 100	K_2O	0.01 – 7	Sn	0.01 – 2	WRX-610
As	0.01 - 2	MgO	0.01 – 40	Sr	0.01 – 2	
Ba	0.01 – 10	Mn	0.01 – 25	TiO_2	0.01 – 50	
CaO	0.01 – 40	Na_2O	0.01 – 10	V	0.01 –5	
Cl	0.01 – 6	Ni	0.01 – 10	Zn	0.01 – 2	
Co	0.01 – 5	P	0.01 – 10	Zr	0.01 – 1	
Cr_2O_3	0.01 – 10	Pb	0.01 – 2	LOI	0.01 – 100	
Cu	0.01 – 2	S	0.01 – 5			
Fe	0.01 – 75	SiO_2	0.01 – 100			

OTHER

DESCRIPTION	DETECTION RANGE	CODE
Specific gravity by weight on core		SPG-410
Specific gravity by weight on pulp		SPG-411
Specific gravity by weight on waxed core		SPG-415
Bulk density on waxed core	g/cm^3	BDE-110
Acid insoluble content	0.01% – 100%	SPE-INS
Moisture determination	0.01% – 100%	PMO-200

COPPER ANALYSIS

DESCRIPTION	DETECTION RANGE (%)	CODE
Citric acid leach, AAS/ICP-ES finish	0.001 – 10	SQL-CA1
Sulfuric acid leach, AAS/ICP-ES finish	0.001 – 10	SQL-AS1
Sulfuric acid/sodium sulfite leach, AAS finish	0.001 – 10	SQL-AS2
Sodium cyanide leach, AAS finish	0.001 – 10	SQL-CN1
Residue, 4-Acid, ICP-ES finish	0.001 – 10	SQL-RE1
Residue, by calculation	0.001 – 10	SQL-RE2
Total Cu, 4-Acid, ICP-ES finish	0.001 – 40	ICF-6Cu
Sequential leach package includes: ICF-6Cu, SQL-AS1, SQL-CN1, SQL-RE2	0.001 – 10	SQL-PK1
PHOTONASSAY™		
Copper		CPA-Cu1

CARBON AND SULFUR ANALYSIS

Total Carbon and Total Sulfur are analyzed directly by induction. All Carbon and Sulfur methods are available separately or as packages.

DESCRIPTION		DETECTION RANGE (%)	CODE
Total C		0.01 — 50	SPM-110
Overlimit C (>50%)		Up to 100	SPM-115
Total inorganic C	Ashed, residue by induction with graphite C correction	0.02 — 50	SPM-120
Total inorganic C	Ashed, residue by induction	0.02 — 50	SPM-125
Total organic C	Measured as the difference between total and ashed C content	0.02 — 50	SPM-130
Graphite C	Ashed, leached, residue measured by induction	0.02 — 50	SPM-140
Complete C Package (Total, Inorganic, Organic, Graphite)			SPM-511
Total C + Total S	C: S:	0.01 — 50 0.01 — 50	SPM-512
Total S		0.01 — 50	SPM-210
Overlimit S (>50%)		Up to 100	SPM—215
Sulfide-S: Total S-Sulfate S-Elemental S		0.01 — 100	SPM-220
Sulfate-S by HCl leach, ICP-ES finish		0.01 — 40	SPM-230
Elemental-S by Solvent extraction, gravimetric finish		0.01 — 100	SPM-240
Complete S Package (Total up to 50%, Sulfide, Sulfate plus elemental Sulphur)			SPM-522

SPECIALTY ASSAY

GRASSROOTS EXPLORATION

The following analytical packages determine low grade elemental occurrence in waters and vegetation. These methods are an invaluable tool to provide you with geochemical information in the hunt for hidden mineralization.

BIOGEOCHEMISTRY

Vegetation and trees can absorb mineral-rich nutrients via root systems from their environments – soil, bedrock, water – and provide the explorationist with significant geochemical information. Vegetation surveys can provide an effective complementary data for deeply buried deposits when establishing geochemical signatures. Macerated or ashed sample analyses are available. The default sample weight for macerated samples is 1g and for ashed samples is 0.25g.

Other sample weights are available on request.

PREPARATION

DESCRIPTION	CODE
Dry and macerate to 1mm, per 100g	PRP-VG1
Dry and ash at 475°C	PRP-VG2
Save all or part of reject fraction	PSC-115

MULTI-ELEMENT IN VEGETATION ICP-MS ULTRA TRACE LEVEL (51 ELEMENTS)

DETECTION RANGE (PPM ULESS OTHERWISE NOTED)						CODE
Ag	0.01 – 100	Ge	0.05 – 500	S	0.01% - 10%	IMS-330
Al	0.01% - 25%	Hf	0.02 – 500	Sb	0.05 – 10,000	
As	0.1 – 10,000	Hg	0.005 – 10,000	Sc	0.1 – 10,000	
Au*	0.5ppb – 25	In	0.005 – 500	Se	0.2– 1,000	
B	10 — 10,000	K	0.01% - 10%	Sn	0.2 – 500	
Ba	10 — 10,000	La	0.2 – 10,000	Sr	0.2 – 10,000	
Be	0.05 – 1,000	Li	0.1 – 10,000	Ta	0.01 – 500	
Bi	0.01 – 10,000	Mg	0.01% - 25%	Te	0.01 – 500	
Ca	0.01% - 25%	Mn	5 — 50,000	Th	0.2 – 10,000	
Cd	0.01 – 1,000	Mo	0.05 – 10,000	Ti	0.01% - 10%	
Ce	0.02 – 500	Na	0.01% - 10%	Tl	0.02 – 10,000	
Co	0.1 – 10,000	Nb	0.05 – 500	U	0.05 – 10,000	
Cr	1 — 10,000	Ni	0.2 – 10,000	V	1 — 10,000	
Cs	0.05 – 500	P	10 — 10,000	W	0.05 – 10,000	
Cu	0.2 – 10,000	Pb	0.2 – 10,000	Y	0.05 – 500	
Fe	0.01% - 50%	Rb	0.1 – 10,000	Zn	1 — 10,000	
Ga	0.05 – 10,000	Re	0.001 – 50	Zr	0.5 – 500	

HYDROGEOCHEMISTRY

Surface and groundwater surveys can be an effective tool in mineral exploration. As water comes in contact with rocks containing ore deposits, minerals may dissolve in the water emulating the chemical composition of the rock. Ultra trace analysis by ICP-MS provides the sensitivity required between background levels and anomalous levels.

Water sampling bottles, 0.45 µm filters, environmental grade nitric acid, and deionized water for field blanks can be provided at cost. Please notify the lab in advance for the supplies prior to sampling.

Minimum sample volume requirement is 25 mls.

MULTI-ELEMENT BY DIRECT READ, ICP-MS ULTRA TRACE LEVEL (65 ELEMENTS)

DETECTION RANGE (PPM ULESS OTHERWISE NOTED)							CODE
Ag	0.01	Eu	0.01	Na	20	Sm	0.01	DIR-IMS
Al	20	Fe	30	Nb	0.01	Sn	0.01	
As	0.05	Ga	0.01	Nd	0.01	Sr	0.01	
Au	0.02	Gd	0.01	Ni	0.1	Ta	0.01	
B	10	Ge	0.05	P	100	Tb	0.01	
Ba	0.01	Hf	0.01	Pd	0.05	Te	0.05	
Be	0.05	Hg	0.1	Pb	0.5	Th	0.01	
Bi	0.01	Ho	0.01	Pr	0.01	Tl	0.01	
Ca	20	In	0.01	Pt	0.05	Tm	0.01	
Cd	0.01	K	10	Rb	0.01	U	0.01	
Ce	0.01	La	0.01	Re	0.004	V	0.1	
Co	0.02	Li	1	S	50	W	0.01	
Cr	0.05	Lu	0.01	Sb	0.05	Y	0.01	
Cs	0.01	Mg	20	Sc	4	Yb	0.01	
Cu	0.05	Mn	0.05	Se	0.5	Zn	0.5	
Dy	0.01	Mo	0.05	Si	10	Zr	0.02	
Er	0.01							
Dilution of samples containing >1% solids							DIL-IMS

Detection Limits are based on samples containing low levels of total dissolved solids (less than 0.1%). Samples containing high levels of total dissolved solids will be diluted prior to analysis and as a result, the cost and detection limits will change.

VOLUMETRIC METHODS – CLASSICAL TITRATION

DESCRIPTION	DETECTION RANGE (%)	CODE
Copper by titration	0.01 - 100	STI-8Cu
Lead by titration	0.01 - 100	STI-8Pb
Zinc by titration	0.01 - 100	STI-8Zn
Iron by titration	0.01 - 100	STI-8Fe
Ferrous Iron (FeO) by titration	0.01 - 100	STI-8FeO
Antimony by titration	0.01 - 100	STI-8Sb

INSTRUMENT NEUTRON ACTIVATION ANALYSIS (INAA)

Instrumental neutron activation analysis is a non-destructive method that is used to determine the concentration of elements in a variety of matrices. A sample is irradiated and as it decays, it produces radioactive nuclides which emits gamma rays whose energies are characteristic to each element. Contact us for more information.

Minimum weight requirement is 25g.

DESCRIPTION	CODE
Au + 33 elements	NAA-120

DETECTION RANGE (PPM ULESS OTHERWISE NOTED)				CODE	
Au	5 - 10,000	Hf	2 – 10,000	Sn	200 – 20,000
Ag	5 - 10,000	Ir	100 – 10,000	Ta	1 – 5,000
As	1 – 20,000	La	5 - 10,000	Tb	1 – 5,000
Ba	100 – 50,000	Lu	1 – 5,000	Te	1 – 5,000
Br	1 – 1,000	Mo	2 – 10,000	Th	0.5 – 10,000
Cd	10 – 1,000	Na	0.05% - 100%	U	0.5 – 10,000
Ce	10 – 10,000	Ni	20 – 20,000	W	2 – 10,000
Co	10 – 20,000	Rb	10 – 20,000	Yb	5 – 5,000
Cr	50 – 20,000	Sb	0.2 – 10,000	Zn	200 – 20,000
Cs	1 – 10,000	Sc	0.5 – 10,000	Zr	500 – 50,000
Eu	2 – 5,000	Se	10 – 5,000		
Fe	0.5% - 100%	Sm	0.2 – 5,000		

METALLURGICAL SERVICES

BULK LEACH EXTRACTABLE GOLD (BLEG) – CYANIDE LEACH

Test uses cyanide to extract gold into solution. These procedures can be applied to geological samples in which fine gold may be present or where gold may be heterogeneously distributed. Advanced BLEG test is also available where it uses multiple sampling periods as well as analysis of the leached solution and the residue to better understand the leachability of the ore.

DESCRIPTION		DETECTION RANGE (PPM)	CODE
BLEG Quick cyanide test, leached solution by AAS		0.01 – 100	AU-CN00
BLEG Leached solution by AAS, Residue by fire assay	500g	0.01 – 100	AU-CN01
	1kg	0.01 – 100	AU-CN04
ADVANCED BLEG			
2hr, 6hr, 24hr, 48hr sampling of cyanide liquor with AAS finish Fire assay of residue before leaching and after 48 hours		0.01 – 100	AU-CN02
METALLURGICAL BLEG			
Multiple sampling periods to determine leach kinetics. Detailed metallurgical balance including head and leach residue assays. Additional options include: Examination of the effect of additional reagents Modification of test parameters such as oxygen levels, temperature and particle size In conjunction with other mineral beneficiation processes.			AU-CN03

PRECIOUS METALS IN METALLURGICAL SAMPLES

DESCRIPTION	DETECTION RANGE (PPM)		CODE
GOLD			
Trace level – Fire Assay/AAS finish	0.005 - 10		MET-FA1
Ore grade – Fire Assay/AAS finish	0.01 - 100		MET-FA2
Concentrate – Fire Assay/ Gravimetric finish	0.9 - 10,000		MET-FA3
SILVER			
Concentrate – Fire Assay/ Gravimetric finish	50 - 10,000		MET-FA5
GOLD AND SILVER			
Concentrate – Fire Assay/Gravimetric Finish	Au: 0.9 - 10,000	Ag: 50 - 10,000	MET-FA7
Gold ore grade – Fire Assay/AAS finish and Silver ore grade – Aqua Regia digestion/ICP-ES finish	Au: 0.01 - 100	Ag: 1 - 1,500	MET-FA8
GOLD, PLATINUM AND PALLADIUM			
Trace Level – Fire Assay/ICP-ES finish	Au, Pd: 0.002 - 10	Pt: 0.005 - 10	PGM-133
Ore Grade – Fire Assay/ICP-ES finish	Au, Pt, Pd: 0.01 - 100		PGM-233

MULTI-ELEMENT PACKAGES FOR METALLURGICAL SAMPLES

MULTI-ELEMENT ICP-ES (33 ELEMENTS)

ORE GRADE – AQUA REGIA DETECTION RANGE (% ULESS OTHERWISE NOTED)						CODE
Ag	1 — 1,500ppm	Fe	0.05 - 50	Pb	0.001 – 5	MET-420
Al	0.05 - 50	Ga	0.01 – 5	S	0.05 – 10	
As	0.001 – 10	Hg	0.001 – 5	Sb	0.001 – 5	
Ba	0.01 - 5	K	0.05 – 50	Sc	0.001 – 5	
Be	0.01 – 5	La	0.005 – 5	Sr	0.001 – 5	
Bi	0.01 – 5	Mg	0.05 – 25	Ti	0.05 – 50	
Ca	0.05 – 50	Mn	0.01 – 25	Tl	0.005 – 5	
Cd	0.001 – 1	Mo	0.001 – 5	V	0.001 – 5	
Co	0.001 – 1	Na	0.05 – 50	W	0.005 – 5	
Cr	0.001 – 5	Ni	0.001 – 5	Zn	0.001 – 15	
Cu	0.001 – 10	P	0.005 – 25	Zr	0.001 – 2	
Any one or more elements available upon request						INA-8xx*

* Insert element symbol for (xx).

MULTI-ELEMENT ICP-ES (29 ELEMENTS)

ORE GRADE – 4-ACID DETECTION RANGE (% ULESS OTHERWISE NOTED)						CODE
Ag	1 – 1,000 ppm	Cu	0.001 – 40	Pb	0.01 – 20	MET-440
Al	0.05 – 30	Fe	0.05 – 50	S	0.05 – 10	
As	0.005 – 10	K	0.1 – 30	Sb	0.005 – 5	
Ba	0.005 – 5	La	0.005 – 5	Sr	0.01 – 10	
Be	0.001 – 1	Mg	0.05 – 50	Ti	0.05 – 30	
Bi	0.005 – 5	Mn	0.01 – 10	Tl	0.005 – 5	
Ca	0.05 – 50	Mo	0.001 – 5	V	0.001 – 10	
Cd	0.001 – 1	Na	0.05 – 30	W	0.01 – 5	
Co	0.001 – 5	Ni	0.001 –10	Zn	0.01 – 40	
Cr	0.001 – 10	P	0.01 – 10			
Any one or more elements available upon request						INF-8xx*

* Insert element symbol for (xx).

PEROXIDE FUSION WITH ICP-ES FINISH (18 ELEMENTS)

DETECTION RANGE (%)						CODE
Al	0.01 – 50	Fe	0.05 – 70	Pb	0.01 – 30	MET-510
As	0.01 – 10	K	0.1 – 30	S	0.01 – 60	
Ca	0.05 – 50	Li	0.05 – 30	Si	0.1 – 50	
Co	0.002 – 30	Mg	0.01 – 30	Sn	0.01 – 30	
Cr	0.01 – 30	Mn	0.01 – 50	Ti	0.01 – 30	
Cu	0.005 – 30	Ni	0.005 – 30	Zn	0.01 – 30	
Any one or more elements available upon request						MET-5xx*

*Insert element symbol for (xx).

DIRECT READ FROM SOLUTION, ICP-ES FINISH (30 ELEMENTS)

DETECTION RANGE (PPM)						CODE
Ag	0.05 - 10	Cu	0.05 - 1,000	Pb	0.5 - 1,000	DIR-ICP
Al	5 - 10,000	Fe	5 - 10,000	S	5 - 10,000	
As	0.2 - 1,000	K	5 - 10,000	Sb	0.2 - 1,000	
Ba	1 - 1,000	La	1 - 1,000	Sn	0.05 - 1,000	
Be	0.05 - 100	Mg	5 - 10,000	Ti	5 - 10,000	
Bi	0.2 - 1,000	Mn	0.5 - 2,000	Tl	0.5 - 1,000	
Ca	5 - 10,000	Mo	0.05 - 1,000	V	0.05 - 1,000	
Cd	0.05 - 100	Na	5 - 10,000	W	0.5 - 1,000	
Co	0.05 - 1,000	Ni	0.05 - 1,000	Zn	0.2 - 1,000	
Cr	0.05 - 1,000	P	0.5 - 10,000	Zr	0.5 - 1,000	
Any one or more elements available upon request						DIR-ICxx*

*Insert element symbol for (xx).

CARBON AND SULFUR ANALYSIS

DESCRIPTION	CODE
C&S	MET-750

Review parameters under Specialty Assay (page 36-38).

METALLURGICAL SERVICES

Our partner laboratory works on the principle that effective process development in extractive metallurgy requires more than just a set of lab tests. It recognizes that every customer and project require support at numerous levels of process development.

The team will help identify the best testing methodologies at each stage of the process development cycle: whether it be mineral beneficiation or metal production.

Testing services include:

GRAVITY CONCENTRATION

Centrifugal gravity concentration, Shaking tables, Spirals, MAT table. Mathematical modelling of full size gravity concentration circuits.

FROTH FLOTATION

Preliminary scoping, detail optimization, closed circuit (locked-cycle) and column options on sulphide, oxide, and industrial minerals.

DENSE MEDIA SEPARATION

Bench-scale and pilot-scale options, heavy liquid, ferrosilicon or magnetite-based media.

CLASSIFICATION

Crushing, grinding, screening, de-sliming and particle size analysis, Bond Ball Mill Work Index.

HYDROMETALLURGY

Cyanide leach test work, including bottle roll, reactor and column leaches, acid and caustic leach testing, Ion exchange and solvent extraction.

PILOT-SCALE ROTARY SCRUBBER TESTING, USED FOR DEPOSITS WITH POTENTIAL CLAY ISSUES

To break up agglomerates or lumps in clay-like deposits to liberate encased target minerals prior to beneficiation.

SETTLING TESTS

Coagulant & flocculent selection, column settling rate measurement.

USEFUL INFORMATION

GRAVIMETRIC FACTORS

GRAVIMETRIC FACTORS		
ELEMENT	OXIDE	CONVERSION FACTOR
Al	Al_2O_3	1.889
Ba	$BaSO_4$	1.669
Ba	BaO	1.116
Be	BeO	2.775
C	CO_2	3.666
Ca	CaO	1.399
Ca	$CaCO_3$	2.497
Cr	Cr_2O_3	1.461
F	CaF_2	2.055
Fe	FeO	1.286
Fe	Fe_2O3	1.430
K	K_2O	1.205
Mg	MgO	1.658
Mg	$MgCO_3$	3.468
Mn	MnO	1.291
Na	Na_2O	1.348
Nb	Nb_2O_5	1.431
Ni	NiO	1.273
P	P_2O_5	2.291
Rb	Rb_2O	1.094
Si	SiO_2	2.139
Sn	SnO_2	1.270
Sr	SrO	1.185
Ta	Ta_2O_5	1.221
Th	ThO_2	1.138
Ti	TiO_2	1.668
U	U_3O_8	1.179
V	V_2O_5	1.785
W	WO_3	1.261
Y	Y_2O_3	1.270
Zr	ZrO_2	1.351

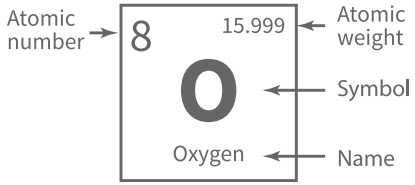
CONVERSION FACTORS

CONVERSION FACTORS	
1 ppm	1,000 ppb
1 ppm	1 g/tonne
1 troy oz/ton	34.286 g/tonne
1 g/tonne	0.0292 troy oz/ton
1%	10,000 ppm

SIEVE SIZES

COMMON SIEVE SIZES	
TYLER MESH	OPENING (µm)
4	4760
10	1680
20	841
35	500
48	297
60	250
80	177
100	149
150	105
200	74
230	63
270	53
325	44
400	37

PERIODIC TABLE



Chemistry is a branch of physical science that studies the composition, structure, properties and change of matter

1 1.008 **H** Hydrogen																	2 4.0026 **He** Helium
3 6.938 **Li** Lithium	4 9.012 **Be** Beryllium											5 10.806 **B** Boron	6 12.0096 **C** Carbon	7 14.0064 **N** Nitrogen	8 15.999 **O** Oxygen	9 18.998 **F** Fluorine	10 20.1797 **Ne** Neon
11 22.989 **Na** Sodium	12 24.304 **Mg** Magnesium											13 26.9815 **Al** Aluminium	14 28.084 **Si** Silicon	15 30.974 **P** Phosphorus	16 32.059 **S** Sulfur	17 35.446 **Cl** Chlorine	18 39.948 **Ar** Argon
19 39.0983 **K** Potassium	20 40.078 **Ca** Calcium	21 44.9559 **Sc** Scandium	22 47.867 **Ti** Titanium	23 50.9415 **V** Vanadium	24 51.9961 **Cr** Chromium	25 54.938 **Mn** Manganese	26 55.845 **Fe** Iron	27 58.933 **Co** Cobalt	28 58.6934 **Ni** Nickel	29 63.546 **Cu** Copper	30 65.38 **Zn** Zinc	31 69.723 **Ga** Gallium	32 72.630 **Ge** Germanium	33 74.922 **As** Arsenic	34 78.971 **Se** Selenium	35 79.901 **Br** Bromine	36 83.798 **Kr** Krypton
37 85.4678 **Rb** Rubidium	38 87.62 **Sr** Strontium	39 88.9058 **Y** Yttrium	40 91.224 **Zr** Zirconium	41 92.906 **Nb** Niobium	42 95.95 **Mo** Molybdenum	43 (98) **Tc** Technetium	44 101.07 **Ru** Ruthenium	45 102.9055 **Rh** Rhodium	46 106.42 **Pd** Palladium	47 107.8682 **Ag** Silver	48 112.414 **Cd** Cadmium	49 114.818 **In** Indium	50 118.710 **Sn** Tin	51 121.760 **Sb** Antimony	52 127.60 **Te** Tellurium	53 126.904 **I** Iodine	54 131.293 **Xe** Xenon
55 132.905 **Cs** Caesium	56 137.327 **Ba** Barium	57-71 Lanthanoids*	72 178.49 **Hf** Hafnium	73 180.948 **Ta** Tantalum	74 183.84 **W** Tungsten	75 186.207 **Re** Rhenium	76 190.23 **Os** Osmium	77 192.217 **Ir** Iridium	78 195.084 **Pt** Platinum	79 196.967 **Au** Gold	80 200.592 **Hg** Mercury	81 204.382 **Tl** Thallium	82 207.2 **Pb** Lead	83 208.980 **Bi** Bismuth	84 (209) **Po** Polonium	85 (210) **At** Astatine	86 (222) **Rn** Radon
87 (223) **Fr** Francium	88 (226) **Ra** Radium	89-103 Actinoids**	104 (267) **Rf** Rutherfordium	105 (268) **Db** Dubnium	106 (269) **Sg** Seaborgium	107 (270) **Bh** Bohrium	108 (277) **Hs** Hassium	109 (278) **Mt** Meitnerium	110 (281) **Ds** Darmstadtium	111 (282) **Rg** Roentgenium	112 (285) **Cn** Copernicium	113 (286) **Nh** Nihonium	114 (289) **Fl** Flerovium	115 (290) **Mc** Moscovium	116 (293) **Lv** Livermorium	117 (294) **Ts** Tennessine	118 (294) **Og** Oganesson

*Lanthanoids	57 138.905 **La** Lanthanum	58 140.116 **Ce** Cerium	59 140.908 **Pr** Praseodymium	60 144.242 **Nd** Neodymium	61 (145) **Pm** Promethium	62 150.36 **Sm** Samarium	63 151.964 **Eu** Europium	64 157.25 **Gd** Gadolinium	65 158.925 **Tb** Terbium	66 162.500 **Dy** Dysprosium	67 164.930 **Ho** Holmium	68 167.259 **Er** Erbium	69 168.934 **Tm** Thulium	70 173.045 **Yb** Ytterbium	71 174.9668 **Lu** Lutetium
**Actinoids	89 (227) **Ac** Actinium	90 232.0377 **Th** Thorium	91 231.036 **Pa** Protactinium	92 238.029 **U** Uranium	93 (237) **Np** Neptunium	94 (244) **Pu** Plutonium	95 (243) **Am** Americium	96 (247) **Cm** Curium	97 (247) **Bk** Berkelium	98 (251) **Cf** Californium	99 (252) **Es** Einsteinium	100 (257) **Fm** Fermium	101 (258) **Md** Mendelevium	102 (259) **No** Nobelium	103 (266) **Lr** Lawrencium

Alkali metal
Alkaline earth metal
Lanthanide
Actinide
Transition metal
Post-transition metal
Metalloid
Polyatomic nonmetal
Diatomic nonmetal
Noble gas
Unknown chemical properties

CONTACT DETAILS

Corporate Head Office

Head Office

Langley
Unit 1, 20120 102nd Avenue
Langley, BC V1M 4B4
Canada
T: +1 604-888-0875
E: customer.service@msalabs.com

Regional Offices

Canada

Prince George
951 Great Street
Prince George, BC V2N 5R7
E: customer.service@msalabs.com

Surrey
Unit 305 19358 96 Avenue
Surrey, BC V4N 4C1
E: customer.service@msalabs.com

Terrace
107-4816 Highway 16 W
Terrace, BC V8G 1L6
T: +1 250-631-0758
E: customer.service@msalabs.com

Timmins
757 Algonquin Boulevard E
Timmins, ON P4N 7E4
E: customer.service@msalabs.com

Val-d'Or
13 Rue Turgeon
Val-d'Or, QC J9P 0A6
T: +1 819-355-2561
E: val-d-or@msalabs.com

Egypt

Industrial Zone Street 103
Marsa Alam
Red Sea Governate
E: customer.service@msalabs.com

Ghana

N217 Kweku Pipim Street
Obuasi, Ashanti Region
E: customer.service@msalabs.com

Guyana

Lot 14 Coldingen Industrial Estate
East Coast Demerara
Georgetown
T: +592 691-6861
E: customer.service@msalabs.com

Mali

Sotuba Bougouba, derrière DNGM
Bamako
E: customer.service@msalabs.com

Mauritania

75 Ilot V, Hangar 3,
Route de l'ancien aéroport,
Le Ksar, (200m left of SOGECO building)
Zone ZGE
Nouakchott
T: + 222 524-5757

Nigeria

PW Nigeria Ltd. Compound
Plot 9, Outer Northern Expressway
Maitama District
Abuja
T: +234 809-600-8161
+234 807-400-5632

Tanzania

Geita Gold Mines Road
PO Box 558
Geita
E: customer.service@msalabs.com

United States

Carlin
2075 Griffin Street
Carlin, NV 89822
E: customer.service@msalabs.com

Elko
355 West River Street
Elko, NV 89801
E: customer.service@msalabs.com

Fairbanks
948 Elizabeth Street
Fairbanks, AK 99709
E: customer.service@msalabs.com

Franchises

Argentina

Boulevard Sarmiento 742 Oeste
Villa Krause
San Juan
T: +54-264-401-3245
E: contact@msalabs.com

Ecuador

Cuenca
Lac y Asociados Cia. Ltda.
Panamericana Sur Km 1
Cuenca, Azuay
T: +593-99-725-3459
E: lac.operations@msalabs.com

Quito
Carlos Puig & Associados
Av. Eloy Alfaro N73-93 y A. Basantes
Quito
E: customer.service@msalabs.com

Finland

CRS Laboratories Oy
Takatie 6
90440 Kempele
T: +358 40-5132015
E: ville.anttila@crs.fi

Kazakhstan

Aurora Minerals Group
12/1 D.Kunaeva Street , VP 17
Astana , 010000
T: +7 (7172) 72-99-33
E: info@aurora.kz

Sweden

MS Analytical AB
Timmervägen 15
SE-923 41
Stensele
T: +46 70-608-6130
E: contact.scandinavia@msanalytical.net


MSALABS

MSALABS

Head Office
Unit 1, 20120 102nd Avenue
Langley, BC V1M 4B4
Canada
T: +1 604-888-0875
E: customer.service@msalabs.com

msalabs.com