

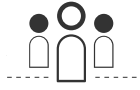


Bureau Veritas Metals, Minerals & Environmental

Schedule of Services & Fees 2020

commodities.bureauveritas.com
bvlab.com





77,000
employees



1,500
offices & laboratories



140
countries

BUREAU VERITAS GLOBAL NETWORK

Created in 1828, Bureau Veritas is a global leader in Testing, Inspection and Certification, delivering high quality services to help clients meet the growing challenges of quality, safety, environmental protection and social responsibility. As a trusted partner, Bureau Veritas offers innovative solutions that go beyond simple compliance with regulations and standards, reducing risk, improving performance and promoting sustainable development. Bureau Veritas' core values include integrity and ethics, impartial counsel and validation, customer focus and safety at work. Bureau Veritas is recognized and accredited by major national and international organizations.

Partner to the global mining industry

Bureau Veritas Minerals (BVM) is the leading global provider of geochemistry, geoanalytical, mineral processing and environmental services to the exploration and mining community. We are by your side throughout the mining value chain: exploration, extraction, processing and transportation. Our services are structured to support the life cycle of your assets, from planning and design through procurement of components and equipment to construction and operation:

- **Reduce risk** in your construction projects through safety assessments, supervision and quality assurance.
- **Achieve consistent quality** by controlling your supply chain and processes.
- **Reassure local stakeholders** by demonstrating conformity with regulations and standards.
- **Preserve the life** of your assets through Asset Integrity Management, inspection and non-destructive testing.
- **Optimize the efficiency** of your operations and maintenance activities.
- **Access expertise** throughout the world thanks to our global network of Technical Centers.

CLOSURE & REMEDIATION

- Acid Rock Drainage (ARD)
- Environmental Chemistry
- Geochemistry
- Radiochemistry
- Tailings & Humidity Cells Testing
- Water Monitoring

OPERATION

- Air Monitoring Testing
- Acid Rock Drainage (ARD)
- Environmental Chemistry
- On-Site Lab Services
- Industrial Hygiene
- Process Optimization
- Product Quality (QAQC)
- Radiochemistry
- Used Oil Analysis
- Water Monitoring Testing



DEVELOPMENT

- Geometallurgy
- Kinetic Testwork
- Mineralogy
- Ore Characterization
- Petrography
- Pilot Plant Assessment
- Radiochemistry

EXPLORATION

- Biogeochemistry
- Environmental Chemistry
- Lithogeochemistry
- Neutron Activation Analysis
- Trace and Ore Grade Assays
- Ultra-Trace Geochemistry
- Water Quality Testing

FEASIBILITY

- Air Quality Testing
- ARD & Metal Leaching
- Ecotoxicology
- Environmental Chemistry
- Industrial Hygiene
- Metallurgy & Mineralogy Testing
- Radiochemistry
- Environmental DNA

Health, Safety & Environmental Statement



Bureau Veritas' services are chosen by thousands of clients over the world to fulfill their needs for testing, inspection and certification services in the fields of Health, Safety, Environment and Social Responsibility. This choice is based on their complete trust in our expertise and our ability to deliver high-quality services. Every delivered service helps to shape this trust. To ensure the sustainability of our business and support the strategic orientation of Bureau Veritas, we are continuously improving employee safety, reducing workplace risks and creating safer working conditions.



HEALTH

Make all workers activities safe
Improve processes



ENVIRONMENT

ISO 14001 certification
Reduce our carbon footprint
Improve financial evaluations score



SAFETY

Reach **ZERO** fatal accidents
ISO 45001 certification
Increase safety culture & behavior
Integrate security in the operational tools



PRINCIPLES

SAFETY: IT'S OUR RESPONSIBILITY at Bureau Veritas. Health and Safety at work is our responsibility. Line management demonstrates leadership and is accountable for compliance. Each employee, sub-contractor and visitor must comply and be alert.

MANAGEMENT SYSTEM

Risks and opportunities are identified and managed especially where they have the potential to cause an accident or injury to people, or unacceptable impacts on the environment or the community. Employees and sub-contractors are empowered to address unsafe or hazardous situations.

RESPONSIBILITY

Provide a safe workplace with systems in place to prevent accidents and injuries, prevent pollution, minimize energy consumption and waste generation. Increase safe behavior by providing employees HSE awareness and compliance with relevant HSE legislation.

Quality Assurance Quality Control

At Bureau Veritas Minerals (BVM) our core product is analytical data. Over many years, we have invested heavily in proprietary software and staff development to ensure that you get the highest quality data. BVM has implemented a comprehensive quality management system meeting the requirements of ISO/IEC 17025 and ISO 9001 to ensure the necessary processes and oversight are in place to achieve this goal.



QUALITY ASSURANCE

Through the process of external auditing by recognized organizations, our facilities maintain ISO registrations and accreditations. These registrations and accreditations provide independent verification that the management systems have been implemented and meet the requirements of the ISO standards. All BVM facilities are registered or are pending registration to ISO 9001 under the Bureau Veritas corporate registration. Additionally a number of analytical hubs have received ISO/IEC 17025 accreditation for specific laboratory procedures.



AUDIT PROGRAM

All BVM facilities are also internally audited against the above ISO standards by knowledgeable and trained personnel on a scheduled basis.

PROFICIENCY TESTING PROGRAMS

BVM laboratories routinely participate in national and international inter-laboratory comparison studies in order to independently assess individual laboratory performance for the test method(s) analyzed.



QUALITY CONTROL

Through comprehensive training, BVM ensures that laboratory staff are competent to perform the analysis requested. All labs use validated methods to achieve accurate reproducible results with equipment that is maintained and calibrated to achieve the highest levels of performance. At all steps of sample handling, the laboratory maintains traceability of samples through the use of barcode tracking and maintains detailed audit trails of the people and equipment used to perform analysis.

In sample preparation

As one of the most critical steps in the sample analysis process, BVM continually monitors the efficiency of crushing and pulverizing to ensure that a representative portion of each sample submitted is prepared. Sample duplicates are created and analyzed for all rock and drill core samples submitted.

In analysis

In addition to routine calibration solutions the laboratory inserts reference materials, replicates and blanks into randomly assigned positions within each analytical rack generated by our proprietary LIMS. These QC materials provide a final verification of the entire analytical process.

In data review and evaluation

This is the final layer that is made up of sophisticated proprietary software and professional personnel reviewing the data.

For more information on the BVM Quality program, refer to the guidance document BVM Quality Control: Definitions and Guidelines for the Interpretation of Quality Control

Infrared Spectroscopy

INFRARED SPECTRAL ANALYSIS AND MACHINE LEARNING

As an exploration project transitions to a mining project, one of the most expensive stages from an analytical perspective is process and mine development and, to a lesser degree, mine production. Many of the geochemical, mineralogical, or physical tests at these stages are costly, thus fewer domained samples are analyzed. Assays become poor proxies for metallurgical characteristics in a block model. Bureau Veritas Minerals' spectral service (VNIR to TIR) plus machine learning can help to optimise resource development by predicting properties that are difficult, costly or time consuming to measure. This analytical technology measures light absorbed by a sample in the infrared (IR) region of the light spectrum [spectral range of VNIR-SWIR-LWIR-TIR (0.35 to 26.5 μm)]. As this technology covers a large wavelength range, it has the ability to predict a diverse range of mineralogical and metallurgical parameters.

Bureau Veritas has successfully completed bauxite, iron ore, base metals, precious metals, and porphyry copper spectral programs. Our service can predict mineralogy, physical properties, ore processing properties, ore classification, geochemistry, and more.

CYCLE	SCOPE OF WORK	ANALYSIS TYPE	ANALYSIS COST	ANALYSIS VOLUMES
Exploration	Geo Assay Mineralogy Ore Characterization	Low Detection Levels Pathfinders	I N N O V A T I O N	Scoping Samples Field Analysis Routine Laboratory
Resource Development	Geo Assay Process Scoping Geomet Studies	Accurate Quantitative Analysis JORC and 43-101 Reporting		Target Samples Routine Laboratory
Process and Mine Development	Feasibility Studies Pilot Plant Product Testing	Mineralogy Recovery Concentrates		Project Samples Research Analysis Proxies
Production	Process Optimisation Product Quality Grade Control Geomet Programs	Tailored Methods for Operations Metal Accounting Transactions		On-Site Lab Fast Turnaround High Accuracy (Trade)

Bureau Veritas' spectral analysis plus ML workflow involves:

- Normal sample preparation methods are used to produce a dried pulp.
- The IR spectra are collected without any additional preparation. There are no digests, fusions or other processes required.
- Collection of fingerprint IR spectra on a calibration set from a given mineral deposit.
- Data analytics and Machine Learning processes are used to build a custom predictive model.
- The model is validated with spectra from known samples from the same deposit, then deployed to the laboratory for predictions on routine samples.

HYLOGGER (VNIR AND SWIR) SPECTROMETRY

The The Hylogger system can be used on core or rock chips for the qualitative determination of an extensive list of minerals including Fe oxides, AlOH group minerals, sulphates, FeOH group, MgOH group, and carbonates.

Application of VNIR and SWIR Analysis:

- Alteration vectoring
- Lithocap investigations
- Geometallurgy applications

Benefits:

- Cost effective mineralogy
- Little sample preparation required (analysis can be conducted on core, or chips)
- Non-destructive
- Easy set-up, on-site application
- Hylogger spectra interpretation service is available

Battery Metals



LITHIUM

Ore grade lithium is most commonly found in pegmatites, hectorite clays, and lithium brines. Most of the world's lithium production is in South America, where lithium-containing brine is extracted from underground pools and concentrated by solar evaporation.



Analytical methods suggested

PF370, MA370

ICPTV-W (Solution)

Metallurgical and mineralogical services



The anode

GRAPHITE

High purity graphite (> 99.95%) is a very important aspect of Li-ion batteries. Currently, approximately 2/3 of all graphite for Li-ion batteries is sourced from natural deposits. The remaining 1/3 is sourced from synthetic processes.



Analytical methods suggested

TC005, TC006, TC007

QEMSCAN & XRD

Cathode metals

COBALT

Currently, the largest cobalt deposits are the stratiform copper/cobalt deposits of the Central African Copper Belt within the Democratic Republic of Congo (DRC). Outside of the DRC, cobalt is typically recovered as a co-product from the mining of magmatic Ni/Cu sulphide and Ni-laterite deposits. The element can also be found in cobalt-silver vein deposits, where it commonly forms Co arsenides. While cobalt grades can be very high in these deposits, so too can arsenic content.



Analytical methods suggested

XF720

PF370, MA370, AQ270-As

Cathode metals

MANGANESE

Manganese ores are generally found in either sedimentary hosted, volcanogenic hosted massive sulphides (VHMS), or karst hosted deposits. Of these 3 types, the sedimentary hosted type is the most common and represents the largest deposits. The majority of Mn ore is mined in South Africa and Australia. Minerals mined are typically braunite, bixbyite, pyrolusite, or hausmannite. Due to the highly refractory nature of these minerals we recommend a very aggressive digestion method.



Analytical methods suggested

PF370

Cathode metals

NICKEL

Nickel is generally associated with cobalt. The most common Ni deposits are either magmatic sulphide, or Ni laterites.



Analytical methods suggested

XF720

MA370, MA270, AQ270-As

Mine Site Laboratory Services



BVM Mine Site Laboratory Services provides high quality customized laboratories supported by our global network of professionals. Our goal is to provide you with a solution that meets your project needs, ranging from a remote mobile prep lab to a full service analytical laboratory at the mine. All labs meet the requirements of ISO 9001 Quality Management Systems and use validated methods and processes which comply with global OH&S standards. As we are the global leader in analytical geochemistry, we will provide you with a customized lab that will minimize costs and liability so your focus can be on mining and exploration.



Access expertise

ONSITE LABORATORY SERVICES

- Sample Prep Lab
- Containerized Lab
- Full Service Lab



MINERAL TESTING SERVICES

- Assaying and geochemical analysis
- Metallurgical testing services
- Mineralogical analysis
- Environmental requirements



QUALITY & INTEGRITY

- ISO accredited laboratories
- Training and onsite laboratory support by qualified BVM Staff
- Latest production scheduling
- Auditing of laboratory procedures and management systems



OUTSOURCING

- Custom designed facilities to improve sample processing efficiency
- Technical diagnosis and service repair of existing equipment to reduce costs
- Installation of new equipment and method development
- Implementation of data management control through LIMS and WebAccess

WebAccess

WebAccess is a secure web interface for our customers to obtain direct access to the Bureau Veritas Upstream Minerals laboratory database. It allows real-time access to any of your jobs logged into our LIMS. Track your samples from reception through the lab and see results any time of the day or night. Tests that indicate the need for a major inspection are double-checked prior to your notification.



Job registering

Sample submission forms, certificates and invoices



Tracking

Project documents such as the pricing quote and template submission form



Assay reports

Analytical methods documents and reference material certificates



QAQC reports

Quality Control documents reviewing analytical performance

CLIENT REAL-TIME ACCESS

SAMPLE TRACKING SYSTEM

BVM uses our secure LIMS (Laboratory Information Management System) to track the flow of every sample through each stage of sample handling and analysis. When received, each sample is barcoded and labelled. This unique barcode is used to build an audit trail that documents the complete history of work performed on each sample. It includes the recording of each person that interacted with the sample and the task that they performed. This tracking feature provides the laboratory with a very high level of control but also provides our clients with an unprecedented level of traceability.

BOX TRACKING SYSTEM

Each barcoded sample is allocated into a barcoded sample box. The barcodes allow BVM to track each box as it moves from one laboratory to another and allows our clients to monitor the progress of their samples from a remote sample preparation facility to the main laboratory. More importantly, this system speeds the flow of the samples through the laboratory to eliminate time consuming manual steps and reduces the risk of human error.

Contents

	CODE	PAGE
Sample Preparation, Storage & Disposal		
Crush 70% 10 mesh and pulverize 250 g	PRP70-250	12
Pulverize to 85% passing 200 mesh	PUL85	12
Standard soil sieve 80 mesh	SS80	12
Precious Metals & Leaches		
Fire Assay Au, Pt, Pd – ICP-ES	FA330	16
Fire Assay Au 30 g – AAS finish	FA430	16
Fire Assay Ag 30 g - Gravimetric	FA530-Ag	16
Fire Assay Au 30 g – Gravimetric	FA530-Au	16
Fire Assay Au and Ag 30 g – Gravimetric	FA530	16
Metallic Screen Fire Assay 50 g duplicate minus fraction	FS652	17
Ore & High Grade Analysis		
Aqua regia Ore Grade AAS	AR402	20
Multi-acid Ore Grade AAS	MA404	20
Aqua regia Ore Grade ICP-ES	AQ370	21
Multi-acid Ore Grade ICP-ES	MA370	21
Zn Titration	GC816	22
Pb Titration	GC817	22
Fe Titration	GC818	22
Cu Titration	GC820	22
Exploration Geochemistry		
Aqua regia – ICP-ES	AQ300	24
Aqua regia – ICP-ES/MS	AQ200	24
Aqua regia – Ultra-trace	AQ250	25
Multi-acid – ICP-ES	MA300	26
Multi-acid – ICP-ES/MS	MA200	26
Aqua regia – ICP-ES/MS Hg	AQ200-Hg	26
Multi-acid – Ultra-trace	MA250	27
Plant Material Analysis	VG101	29
Generative Exploration Package	GENX10	31
Litho geochemistry		
Lithium Borate Fusion – Refractory and REEs	LF100	34
Total Whole Rock Characterization	LF202	34
Whole Rock Lithium Fusion ICP Finish	LF300	34
Leco – Total C and S	TC000	35
XRF – Fusion – Major Oxides	XF700	35
XRF – Fusion – Iron Ore	XF732	36
XRF – Fusion – Laterites	XF720	37
Laser Ablation Package	LA001-EXT + XRF	38
Metallurgy & Mineralogy		
Mineral Processing		40
Hydrometallurgy		41
Mineralogy & Petrography		42
Environmental Services		
Environmental Chemistry		45
Trace Metals		46
Ecotoxicology		47
Acid Rock Drainage		49
Radiochemistry		50
Industrial Hygiene		52
Ambiant Air Quality		54
Environmental DNA (eDNA)		55
Metals and Diamond Mining Effluent Regulations (MDMER)		56
Global Footprint Map		
		58



SAMPLE PREPARATION, STORAGE & DISPOSAL

The Bureau Veritas Minerals sample preparation process incorporates several important steps. These steps lay the groundwork for all analyses and is key to the overall high quality of the analytical results. Included in these steps is:

- Sample log-in and reconciliation against the client-supplied list. An electronic reconciliation is sent out for each job, which indicates methods, any potential missing samples, TAT, etc.
- Sample drying.
- Crushing and pulverizing rock, core or other solid media, or sieving soils and sediments. The lab typically crushes the entire sample and the sample mass to be pulverized can be varied based on client preference.
- Most importantly, our labs undertake a rigorous QAQC program to ensure consistent results. A sieve test is used to monitor the process on select and random samples at the primary crushing and pulverizing stage, as well as monitor the wear surfaces of plates, bowls and other equipment problems.

These tests are recorded and produced for your review. If there is a non-conformance in the quality standard, the process is reviewed and corrected. This rigorous policy applies to any material that is reported or used in the analytical process.

Sample Preparation, Storage & Disposal

The packages listed here are the most common methods applied in our industry. If you require custom sample preparation techniques please contact your local account manager or lab nearest to your project to discuss in more detail. You will find our team of professionals and technical group second to none in our ability to provide support.

ROCK AND CORE PREPARATION

CODE	DESCRIPTION	CAD
PRP70-250	Crush 1 kg to $\geq 70\%$ passing 2mm - Pulverize 250 g $\geq 85\%$ 75 μ m	\$8.15
	Extra crushing over 1 kg, per kg	+ \$0.80
PRP70-500	Crush 1 kg to $\geq 70\%$ passing 2mm - Pulverize 500 g $\geq 85\%$ 75 μ m	\$9.30
	Extra crushing over 1 kg, per kg	+ \$0.80
PRP70-1Kg	Crush 1 kg to $\geq 70\%$ passing 2mm - Pulverize 1 kg $\geq 85\%$ 75 μ m	\$10.50
	Extra crushing over 1 kg, per kg	+ \$0.80
PRP80-250	Crush 1 kg to $\geq 80\%$ passing 2mm - Pulverize 250 g $\geq 85\%$ 75 μ m	\$9.20
	Extra crushing over 1 kg, per kg	+ \$1.10
PRP90-250	Crush 1 kg to $\geq 90\%$ passing 2mm - Pulverize 250 g $\geq 85\%$ 75 μ m	\$9.55
	Extra crushing over 1 kg, per kg	+ \$1.50
CRU70	Crush to $\geq 70\%$ passing 2mm per kg, includes first 1 kg	\$3.95
	Extra crushing over 1 kg, per kg	+ \$0.80
CRUPR	Primary Crushing for large samples, (eg. whole core), per kg	\$1.10
PUL85	Dry and pulverize to $\geq 85\%$ passing 75 μ m	\$4.15
	Extra pulverizing over 250 g, per 250 g	+ \$1.05
DY105	Dry pulp at 105°C, per sample	\$0.70
HOMG	Homogenizing of pulps by light pulverizing	\$2.90
SPTRF	Split by riffle splitter up to 5 kg of -2 mm sample, per sample	\$2.45
WGHT	Weigh sample	\$0.75
CRUBW	Extra wash with barren material – crushing	\$2.85
PULSW	Extra wash – silica – pulverizing	\$3.40
SPTRS	Rotary split up to 5 kg	\$5.00

Other size fractions / preparation requirements available upon request. For example ceramic bowl pulverizing, different size crushing and bowl sizes, etc.

SOILS

CODE	DESCRIPTION	CAD
SS80	Dry at 60°C, sieve to depletion to -180 μ m (80 mesh) up to 1 kg sample (discard plus fraction)	\$3.65
	Overweight sieving per 500 g - extra sieving over 1 kg	\$1.20
SS230	Dry at 60°C, sieve 100 g to -63 μ m (230 mesh), up to 1 kg sample	\$4.60
	Overweight sieving per 500 g	\$1.70
	Other sieve sizes available upon request	by quote
PULSL	Pulverize soils in mild steel pulverizer, per 100 g	\$3.55
SVRJT	Saving all or part of soil reject	\$1.10
CLYSP	Clay separation up to 500 g (for other weight requirements please contact us)	\$16.85
DISP2	Heat treatment of soils and sediments, per sample (All international soil shipments to Canada)	\$0.55

Important note regarding soils: Importation regulations may apply; contact lab prior to shipment for details and shipment requirements. For soil shipments to Canada: No soil, till, sediment pulps or rejects can be returned and must be incinerated prior to disposal. A disposal fee (DISP2) is charged for these samples. Soil rejects are discarded immediately after preparation unless SVRJT is requested.

Sample Submission Analysis



SHIPPING INSTRUCTIONS

Go to [our website](#) and download our **Analysis Request Form** (english or spanish available)

- Fill in the form clearly by following step by step instructions (do not alter form format)
- Company information, quote number, project, Shipment ID, name, email and phone number

- Client details, invoice & report
- Mode of data transmittal (CSV, PDF, email),
- Method of analysis desired or package requested
- Special instructions
- Rush service needed
- Storage and disposal (reject or pulps) after analysis
- Don't forget to sign

PACKAGING INSTRUCTIONS

- Pack the samples securely, ensuring that each sample is clearly labeled with a sample number.
- Please identify any high grade samples – this helps us to reduce the risk of cross contamination.

SOILS INSTRUCTIONS (TO AND WITHIN) CANADA

Bureau Veritas will provide a CFIA Permit needed to clear soil samples expeditiously through Canada Customs. Permits are specific for the country of sample shipment origin and valid for one year. A copy of the permit must accompany each shipment. Shipments cleared through Canada Customs for no charge.

ENVIRONMENTAL FEE

As part of our commitment to minimizing the environmental impact of our business activities, Bureau Veritas Minerals has migrated to a single green fee charge to cover all waste charges incurred by the laboratories. This fee, EN004, covers charges for cardboard and plastic recycling, hazardous waste disposal, emissions testing and monitoring, permitting fees and ongoing sustainability initiatives. This code replaces individual environmental waste charges such as EN002 for lead waste disposal and EN001-MA for acid waste disposal.



CODE	DESCRIPTION	CAD
EN004	Environmental fee charge	\$0.90

SPECIFIC GRAVITY

CODE	DESCRIPTION	CAD
SPG02	Specific Gravity on core by water displacement	\$14.85
	Surcharge over 2 kg	\$5.35
SPG03	Specific Gravity on waxed core (wax removal not included)	\$20.05
SPG04	Specific Gravity on pulps or rock chips by gas pycnometer	\$14.30

MISCELLANEOUS CHARGES

CODE	DESCRIPTION	CAD
PULHP	Hand pulverize by mortar and pestle	\$9.40
QCCHK	Additional QC checks	\$3.55
HAND	Handling of special projects, per hour	\$75.00
SHP-01	Shipping charge (pulps), per sample - from branch (varies by country)	From \$2.25
SPTPL	Extra splitting of pulp	\$1.10
PULSW	Extra wash with silica-pulverizing	\$3.40
DYAIR	Air Dry samples, (<40°C), per 2 kg	\$2.70
DYXS	Drying surcharge for excessively wet samples	\$2.10
	Surcharge over, 1 kg, per kg	+ \$0.50
SLBHP	Sorting, Labeling, Boxing and Handling samples received as Pulps	\$1.10
BAT01	Batch charge for <20 samples	\$55.00
VAC01	Vacuum seal samples, nitrogen purge	\$11.25
CRCUT	Core Cutting	by quote
PICKUP	Shipping charges for samples pick up	by quote



WAREHOUSE CHARGES

CODE	DESCRIPTION	CAD
SPRTRN	Cost of shipping returns	at cost
DISRJ	Dispose of reject	\$0.80
DISPL	Dispose of pulps	\$0.20
WHRJT	Monthly storage of reject after 60 days	\$0.75
WHPLP	Monthly storage of pulps after 90 days (up to 250 g sample)	\$0.35
WHS01	Warehouse handling, per hour	\$75.00
WHSRT	Monthly storage of soil rejects after 60 days	\$0.45

Storage information: All samples rejects are stored for 2 months and pulps for 3 months at no charge and will be disposed of without notification unless storage is requested at the time of submission. A minimum charge of \$10/quarter (\$40/yr) will apply to all clients with samples in storage. When storage is requested on receipt, storage will be charged up front to cover the first 6 months. All disposal, handling or shipping charges for concentrates, high norm samples and samples containing hazardous materials will be borne by the client.



PRECIOUS METALS & LEACHES

Methods in this section include industry standard fire assay options for gold, silver, platinum and palladium. From a basic 30 g charge to full metallic screen fire assay, reliable data is achieved for all sample types including those with coarse gold. Bulk leaching of gold bearing materials using cyanide is also available and provides an additional tool to evaluate systems with unevenly distributed gold and to test for extractability. Selective and sequential leaches are also included in this section to provide information on the distribution of copper within various phases in the sample.

AQUA REGIA GOLD

Recommended for soils, sediments, vegetation or reconnaissance rock samples. Samples are digested in 1:1:1 aqua regia then analyzed by ICP-MS. Refractory, massive sulphide and graphitic samples can limit Au solubility.

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	DESCRIPTION	CAD
AQ115				15 g Aqua regia ICP-MS	\$11.55
AQ130				30 g Aqua regia ICP-MS	\$16.50
AQ115-IGN	Au	0.5 ppb	10 ppm	Ignited 15 g Aqua regia ICP-MS Rock samples are ignited at 550°C before aqua regia digestion	\$13.00
AQ130-IGN				Ignited 30 g Aqua regia ICP-MS Rock samples are ignited at 550°C before aqua regia digestion	\$17.95

Fire Assay

Lead collection fire assay fusion is a classic method for total sample decomposition. Total Au content is determined by digesting an Ag dore bead and then analysing by AAS, ICP-ES, or ICP-MS. The Lab reserves the right to reduce sample weight to 15 g or less for proper fusion.

ICP-MS

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	DESCRIPTION	CAD
	Au	1 ppb	1 ppm		
FA130				30 g / Fire Assay / ICP-MS	\$23.40
FA150	Pt	0.1 ppb	1 ppm	50 g / Fire Assay / ICP-MS	\$26.50
	Pd	0.5 ppb	1 ppm		

ICP-ES

FA330-Au*				30 g / Fire Assay / ICP-ES	\$18.40
FA350-Au*	Au	2 ppb	10 ppm	50 g / Fire Assay / ICP-ES	\$21.75
	Au	2 ppb	10 ppm		
FA330*				30 g / Fire Assay / ICP-ES	\$19.70
FA350*	Pt	3 ppb	10 ppm	50 g / Fire Assay / ICP-ES	\$22.80
	Pd	2 ppb	10 ppm		

AAS

FA430*				30 g / Fire Assay / AAS	\$17.30
FA450*	Au	0.005 ppm	10 ppm	50 g / Fire Assay / AAS	\$20.55

GRAVIMETRIC

FA530-Ag				30 g / Fire Assay / gravimetric	\$21.85
FA550-Ag	Ag	20 ppm		50 g / Fire Assay / gravimetric	\$25.00
FA530-Au				30 g / Fire Assay / gravimetric	\$21.85
FA550-Au	Au	0.9 ppm		50 g / Fire Assay / gravimetric	\$25.00
FA530				30 g / Fire Assay / gravimetric	\$21.85
FA550	Au, Ag	as above		50 g / Fire Assay / gravimetric	\$25.00

Require at least 15 g sample weight.

*Au>10 ppm are automatically analyzed by gravimetric method.



METALLIC SCREEN FIRE ASSAY

Metallic screen fire assay prices include screening of sample to 106 μm . Additional preparation charges for crushing and pulverizing may apply. Alternative screen sizes/weights available upon request. Pricing is based on gravimetric analysis of the plus fraction and instrumentation on the minus fraction. Additional charges for gravimetric analysis on the minus fraction may apply. Please contact your local office to develop the right package for your project.

CODE	ELEM	DETECTION LIMIT	DESCRIPTION	CAD
FS631	Au	0.05 ppm	Metallic Fire Assay single minus fraction analyzed, 30 g - 500 g screen	\$49.00
FS631-1 Kg	Au	0.05 ppm	Metallic Fire Assay single minus fraction analyzed, 30 g - 1 kg screen	\$61.15
FS632	Au	0.05 ppm	Metallic Fire Assay duplicate minus fraction analyzed, 30 g - 500 g screen	\$57.90
FS652	Au	0.05 ppm	Metallic Fire assay duplicate minus fraction analyzed, 50 g - 500 g screen	\$65.75
FS652-1Kg	Au	0.05 ppm	Metallic Fire assay duplicate minus fraction analyzed, 50 g - 1 kg screen	\$74.50

OTHER CHARGES



CODE	DESCRIPTION	CAD
EN004	Environmental fee charge	\$0.90
CHPOT	Stipulate new crucible for fire assay fusion	\$1.65

WET ASSAY SILVER - ORE GRADE

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	DESCRIPTION	CAD
AR401-Ag	Ag	1 ppm	800 ppm	Aqua Regia Digestion AAS Finish	\$12.75
MA401-Ag	Ag	1 ppm	800 ppm	Multi-acid Digestion AAS Finish	\$14.20

PACKAGES FOR REGIONAL NEEDS - CONTACT BEFORE SHIPMENT

CARBONS, CONCENTRATES & HIGH GRADE

This method is ideal for the determination of Au and Ag when higher levels of precision are required. Our stringent quality control protocols involve the use of replicate assays and reference materials suited to the analysis to confirm accuracy. Results are not for commercial settlement purposes. Contact Bureau Veritas Commodities – Metals & Minerals Trade for commercial sampling and testing services where results are to be used for commercial settlement and/or financial transactions.

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	DESCRIPTION	CAD
FA501-Au	Au	10 ppm	100000 ppm	2 g sample Fire Assay for concentrates, duplicate analyses	\$89.10
FA501-Ag	Ag	100 ppm	100000 ppm	2 g sample Fire Assay for concentrates, duplicate analyses	\$89.10
FA501	Au, Ag	as above	as above	2 g sample Fire Assay for concentrates, duplicate analyses	\$110.30

Note: Additional base metal elements may be added for an additional analytical charge

*Shipment costs may apply to ship to Reno & Hermosillo

GOLD BASE METAL LEACHES

Cyanide leaching can offer an alternative to classic fire assay methods with a comparable low detection limit. However, cyanidation analytical tests provide a more realistic estimation of gold and silver recovery from a rock pulp. Gold recovery can be impacted by organic carbon, graphite, and some sulphide minerals.

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	DESCRIPTION	CAD
BL001	Au			Please call to discuss	by quote
CN400	Au, Ag, Cu			Cyanide leach (various options)	by quote
CN401	Au	0.03 ppm	50 ppm	15 g, 1 hour room temperature cyanide shake, AAS finish	\$10.35
CN403	Au	0.03 ppm	50 ppm	30 g, 1 hour room temperature cyanide shake, AAS finish	\$11.75
CN401H	Au	0.03 ppm	50 ppm	15 g, 1 hour hot cyanide shake, AAS finish	\$12.90
CN403H	Au	0.03 ppm	50 ppm	30 g, 1 hour hot cyanide shake, AAS finish	\$14.15
				Extra element	+ \$5.50
PL415	Au	0.03 ppm	500 ppm	Preg rob leach-2 cyanide leaches with and without Au spiked solution <ul style="list-style-type: none"> • < 15 g sample • 30 g sample 	\$12.70
PL430					each leach \$13.20
GC850		0.01 kg H ₂ SO ₄ /TON		Sulphuric leach, net acid consumption	each leach \$34.00

Note: Additional base metal elements (Fe, Zn, Pb) may be added to some leaches for an additional analytical charge. Please contact the laboratory regarding your specific analytical requirements.

COPPER LEACHES

The following methods are used for the determination of Cu leachability, mineralogy and mineral solubility. These methods utilize laboratory standard leach conditions; however client specific conditions can be negotiated upon request.

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	DESCRIPTION	CAD
LH401	CuS	0.001%	10%	1M Citric acid leach with AAS finish - Cu oxides	\$14.20
LH402	CuSH	0.001%	10%	Sulphuric acid leach with AAS finish - nonsulphide Cu	\$14.20
LH403	CuCN	0.01%	10%	Cyanide leach with AAS finish (1 g)	\$15.20
LH425	CuSAP	0.01%	100%	Quick ferric sulphate leach for 1hr Cu by AAS	\$13.20
LHSEQ	CuSH CuCN CuRes			Sample is sequentially leached in H ₂ SO ₄ (LH402), CN (LH403) then Multi-acid, with Cu from each leach reported. Total Copper can be reported as a sum of the leaches.	\$51.70



ORE & HIGH GRADE ANALYSIS

Methods in this section are designed to provide the high precision and accuracy required to quantify commodity elements for resource evaluation. Digestion methods and reagents are chosen to effectively deal with high analyte concentrations. They are coupled with the most stable and matrix tolerant analytical platforms available to produce data of the highest quality. A variety of classical wet assay methods are also available for samples that exceed the maximum concentrations that can be determined instrumentally.

AAS Analysis

Aqua regia and multi-acid digestions with AAS analysis are optimized for moderate to high grade ore samples and select target elements. These methods can be set up to be triggered automatically or selected as standalone packages.



AAS ANALYSIS

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD	
MA401	Ag	1 ppm	800 ppm	\$14.20 for the first Element	
	Cu	0.001 %	10 %		
	Fe	0.01 %	10 %		
	Pb	0.01 %	10 %		
	Zn	0.01 %	10 %		
MA401-Mo	Mo	0.001 %	10 %		
	Cu	0.001 %	10 %		
MA404	Ag	2 ppm	1500 ppm		\$4.30 Additional Element
	Cu	0.01 %	30 %		
	Fe	0.01 %	30 %		
	Ni	0.01 %	30 %		
	Pb	0.01 %	20 %		
	Zn	0.01 %	30 %		

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD	
AR401	Ag	1 ppm	800 ppm	\$12.75 for the first Element	
	Cu	0.001 %	10 %		
AR402	Ag	2 ppm	1000 ppm		
	Cu	0.001 %	10 %		
	Pb	0.01 %	10 %		
	Zn	0.01 %	10 %		
AR404	Ag	2 ppm	1500 ppm		\$4.30 Additional Element
	Cu	0.001 %	20 %		
	Pb	0.01 %	20 %		
	Zn	0.01 %	20 %		

ICP Analysis

The following multi-element assays provide optimum precision and accuracy for high grade rock and drill core samples with a selection of digestion methods to best suit the ore type. AQ370, MA370 and PF370 report percent level concentrations as determined by ICP-ES.

AQUA REGIA ICP-ES

Modified Aqua regia digestion for base-metal sulphide and precious metal ores. Aqua regia digestion is considered a partial digestion. Solubility of some elements will be limited by the mineral species present.

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD
AQ370	Aqua Regia ICP-ES, 24 elements			\$17.20
	Ag	2 ppm	1000 ppm	
	Al	0.01 %	40 %	
	As	0.01 %	10 %	
	Bi	0.01 %	1 %	
	Ca	0.01 %	40 %	
	Cd	0.001 %	1 %	
	Co	0.001 %	1 %	
	Cr	0.001 %	5 %	
	Cu	0.001 %	10 %	
	Fe	0.01 %	40 %	
	Hg	0.001 %	1 %	
	K	0.01 %	40 %	
	Mg	0.01 %	40 %	
	Mn	0.01 %	20 %	
	Mo	0.001 %	5 %	
	Na	0.01 %	25 %	
	Ni	0.001 %	10 %	
	P	0.001 %	25 %	
	Pb	0.01 %	4 %	
	S	0.05 %	30 %	
	Sb	0.001 %	5 %	
	Sr	0.001 %	1 %	
	W	0.001 %	1 %	
	Zn	0.01 %	20 %	
AQ370-X	Aqua Regia ICP-ES, any 1 element			\$12.45

Requires at least 2 g per sample.

PHOSPHORIC ACID ICP-ES

Phosphoric acid digestion for select elements.

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD
KP300	Phosphoric Acid, ICP-ES, 5 elements			\$19.70
	Mo	0.001 %	40 %	
	Nb	0.001 %	40 %	
	Ta	0.001 %	60 %	
	U	0.001 %	60 %	
	W	0.005 %	40 %	
KP300-X	Phosphoric Acid, ICP-ES, any 1 element			\$15.50

Requires at least 2 g per sample.

MULTI-ACID ICP-ES

Multi-acid digestion for sulphide and silicate ores.

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD
MA370	Multi -acid ICP-ES, 23 elements			\$19.70
	Ag	2 ppm	1500 ppm	
	Al	0.01 %	40 %	
	As	0.02 %	10 %	
	Bi	0.01 %	2 %	
	Ca	0.01 %	50 %	
	Cd	0.001 %	2 %	
	Co	0.001 %	2 %	
	Cr	0.001 %	5 %	
	Cu	0.001 %	10 %	
	Fe	0.01 %	60 %	
	K	0.01 %	40 %	
	Mg	0.01 %	40 %	
	Mn	0.01 %	20 %	
	Mo	0.001 %	5 %	
	Na	0.01 %	25 %	
	Ni	0.001 %	10 %	
	P	0.01 %	25 %	
	Pb	0.02 %	10 %	
	S	0.05 %	30 %	
	Sb	0.01 %	1 %	
	Sr	0.01 %	1 %	
	W	0.01 %	1 %	
	Zn	0.01 %	40 %	
MA370-X	Multi -acid ICP-ES, any 1 element			\$14.75

Requires at least 1 g per sample.

Digestion is partial for some Cr and Ba minerals and oxides of Al, Fe, Hf, Mn, Sn, Ta, Zr and REEs. Volatilization during fuming may result in loss of As, S, Se and Sb.

PEROXIDE FUSION ICP-ES

Sodium peroxide fusion for refractory mineral ores.

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD
PF370	Peroxide Fusion ICP-ES, 17 elements			\$38.00
	Al	0.01 %	50 %	
	As	0.01 %	10 %	
	Ca	0.05 %	50 %	
	Co	0.002 %	30 %	
	Cr	0.01 %	30 %	
	Cu	0.005 %	30 %	
	Fe	0.05 %	70 %	
	K	0.01 %	30 %	
	Li	0.001 %	50 %	
	Mg	0.01 %	30 %	
	Mn	0.01 %	70 %	
	Ni	0.005 %	30 %	
	Pb	0.03 %	30 %	
	S	0.01 %	60 %	
	Sn	0.005 %	50 %	
	Ti	0.01 %	30 %	
	Zn	0.01 %	30 %	
PF370-X	Peroxide Fusion ICP-ES, any 1 element			\$20.20

Requires at least 2 g per sample.

MERCURY

CODE	DESCRIPTION	DETECTION LIMIT	UPPER LIMIT	CAD
AQ200-Hg	Hg – ICP-MS	0.01 ppm	50 ppm	\$13.15
CV400	Trace Hg – CVAA	0.01 ppm	100 ppm	\$10.40

WATER AND GENERAL CHEMISTRY

CODE	DESCRIPTION	DETECTION LIMIT	UPPER LIMIT	CAD
GC002	pH and conductivity on solids			\$18.70
GC002-COND	Conductivity of solids	3 µS/cm		\$14.00
GC002-pH	pH of solids	0.1 units		\$11.10
GC901	Moisture (105°C)			\$8.75
GC902	Lattice water			\$30.10
TG001	LOI	0.1 %	100 %	\$10.20

OTHER TRACE AND ORE GRADE ANALYSES

CODE	DESCRIPTION	DETECTION LIMIT	UPPER LIMIT	CAD
BR405	Select elements by HBr digestion, AAS	Please call to discuss		\$30.00
	Additional Element			+ \$5.00
GC204	Ge or Ga by ICP-MS	1 ppm	2000 ppm	\$23.60
	Second element			+ \$4.30
GC304	Ge or Ga by ICP-ES	0.01 %	100 %	\$19.40
	Second element			+ \$4.30
GC320	Ba by Na ₂ CO ₃ /K ₂ CO ₃ fusion, ICP-ES	0.01 %	30 %	\$30.40
GC410	NiS	0.001 %	100 %	\$30.10
GC519	SiO ₂ gravimetric	0.1 %	100 %	\$28.95
GC520	Ba by Na ₂ CO ₃ /K ₂ CO ₃ fusion, gravity	0.1 %	100 %	\$30.40
GC806	FeO Titration	0.2 %	100 %	\$26.40
GC816	Zn Titration	1.00 %	100 %	\$33.00
GC817	Pb Titration	2.00 %	100 %	\$37.00
GC818	Fe Titration	1.00 %	100 %	\$38.75
GC819	Mn Titration	1.00 %	100 %	\$35.30
GC820	Cu Titration	1.00 %	100 %	\$45.40
GC840	F – Trace Level	10 ppm	10000 ppm	\$18.90
GC841	F – Ore Grade	0.01 %	15 %	\$19.95
	Surcharge samples > 15%	10 %	50 %	\$19.95
GC923	Pb or Zn Oxide	0.01 %	10 %	\$27.55
	Additional element			+ \$4.30
PF100	B	3 ppm	2000 ppm	\$17.55

OTHER CHARGES



CODE	DESCRIPTION	CAD
EN004	Environmental fee charge	\$0.90



EXPLORATION GEOCHEMISTRY

Methods in this section are designed for nonmineralized to weakly mineralized material. They have been optimized to provide trace to ultra-trace detection limits and maximum anomaly to background contrast. Modified aqua regia (1:1:1 HNO₃:HCl:H₂O) packages target labile elements in soil, to more aggressive multi-acid digestions that are near total for almost all matrices. For projects with a gold focus, larger sample sizes are available to provide the most representative sample possible and mitigate nugget effects. This section also includes methods designed specifically for other media including biogeochemical exploration and natural water.

Aqua Regia

Using a modified aqua regia digestion (1:1:1 HNO₃:HCl:H₂O), a partial digest can provide valuable information regarding mobile and easily soluble species, such as sulphides. Economically priced ICP-ES (AQ300) or ICP-ES/MS (AQ200) analyses are designed to complement your exploration project. Sample splits of 0.5 g, 15 g or 30 g are leached in modified aqua regia. Select a larger split size for more representative Au analysis. Refractory and graphitic samples can limit Au solubility.

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD
AQ300	Aqua Regia ICP-ES, 33 elements, 0.5 g			\$10.70
	Ag	0.3 ppm	100 ppm	
	Al	0.01 %	10 %	
	As	2 ppm	10000 ppm	
	B	20 ppm	2000 ppm	
	Ba	1 ppm	10000 ppm	
	Bi	3 ppm	2000 ppm	
	Ca	0.01 %	40 %	
	Cd	0.5 ppm	2000 ppm	
	Co	1 ppm	2000 ppm	
	Cr	1 ppm	10000 ppm	
	Cu	1 ppm	10000 ppm	
	Fe	0.01 %	40 %	
	Ga	5 ppm	1000 ppm	
	Hg	1 ppm	50 ppm	
	K	0.01 %	10 %	
	La	1 ppm	10000 ppm	
	Mg	0.01 %	30 %	
	Mn	2 ppm	10000 ppm	
	Mo	1 ppm	2000 ppm	
	Na	0.01 %	5 %	
	Ni	1 ppm	10000 ppm	
	P	0.001 %	5 %	
	Pb	3 ppm	10000 ppm	
	S	0.05 %	10 %	
	Sb	3 ppm	2000 ppm	
	Sc	5 ppm	100 ppm	
	Sr	1 ppm	2000 ppm	
	Th	2 ppm	2000 ppm	
	Ti	0.001 %	5 %	
	Tl	5 ppm	1000 ppm	
	U	8 ppm	2000 ppm	
	V	1 ppm	10000 ppm	
	W	2 ppm	100 ppm	
	Zn	1 ppm	10000 ppm	

Aqua Regia digestion is considered a partial digestion. Solubility of some elements will be limited by mineral species present.

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD
AQ200	Aqua Regia ICP-ES/MS, 36 elements, 0.5 g			\$17.85
AQ201	Aqua Regia ICP-ES/MS, 36 elements, 15 g			\$22.60
AQ202	Aqua Regia ICP-ES/MS, 36 elements, 30 g			\$27.35
	Ag	0.1 ppm	100 ppm	
	Al	0.01 %	10 %	
	As	0.5 ppm	10000 ppm	
	Au	0.5 ppb	100000 ppb	
	B*	20 ppm	2000 ppm	
	Ba	1 ppm	10000 ppm	
	Bi	0.1 ppm	2000 ppm	
	Ca	0.01 %	40 %	
	Cd	0.1 ppm	2000 ppm	
	Co	0.1 ppm	2000 ppm	
	Cr	1 ppm	10000 ppm	
	Cu	0.1 ppm	10000 ppm	
	Fe	0.01 %	40 %	
	Ga	1 ppm	1000 ppm	
	Hg	0.01 ppm	50 ppm	
	K	0.01 %	10 %	
	La	1 ppm	10000 ppm	
	Mg	0.01 %	30 %	
	Mn	1 ppm	10000 ppm	
	Mo	0.1 ppm	2000 ppm	
	Na	0.001 %	5 %	
	Ni	0.1 ppm	10000 ppm	
	P	0.001 %	5 %	
	Pb	0.1 ppm	10000 ppm	
	S	0.05 %	10 %	
	Sb	0.1 ppm	2000 ppm	
	Sc	0.1 ppm	100 ppm	
	Se	0.5 ppm	100 ppm	
	Sr	1 ppm	2000 ppm	
	Te	0.2 ppm	1000 ppm	
	Th	0.1 ppm	2000 ppm	
	Ti	0.001 %	5 %	
	Tl	0.1 ppm	1000 ppm	
	U	0.1 ppm	2000 ppm	
	V**	1 ppm	10000 ppm	
	W	0.1 ppm	100 ppm	
	Zn	1 ppm	10000 ppm	

*Detection limit = 1 ppm for 15/30 g analysis.

**Soils = 2 ppm.

ULTRA-TRACE BY ICP-MS

ICP-MS analysis of a 0.5, 15 or 30 g sample after modified aqua regia digestion (1:1:1 HNO₃:HCl:H₂O) for low to ultra-low determination on soils, sediments and lean rocks. Larger splits (15 or 30 g) give a more representative analysis of elements subject to nugget effect (e.g., Au). Gold solubility can be limited in refractory and graphitic samples. The lead isotope method adds ²⁰⁴Pb, ²⁰⁶Pb, ²⁰⁷Pb, ²⁰⁸Pb. This data is suitable for geochemical exploration of U and other commodities where gross differences in non-radiogenic to radiogenic Pb ratios are of benefit.

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD
AQ250	Aqua Regia ICP-ES/MS, 37 elements, 0.5 g			\$22.05
AQ251	Aqua Regia ICP-ES/MS, 37 elements, 15 g			\$26.80
AQ252	Aqua Regia ICP-ES/MS, 37 elements, 30 g			\$31.55
	Ag	2 ppb	100000 ppb	
	Al	0.01 %	10 %	
	As	0.1 ppm	10000 ppm	
	Au	0.2 ppb	100000 ppb	
	B*	20 ppm	2000 ppm	
	Ba	0.5 ppm	10000 ppm	
	Bi	0.02 ppm	2000 ppm	
	Ca	0.01 %	40 %	
	Cd	0.01 ppm	2000 ppm	
	Co	0.1 ppm	2000 ppm	
	Cr	0.5 ppm	10000 ppm	
	Cu	0.01 ppm	10000 ppm	
	Fe	0.01 %	40 %	
	Ga	0.1 ppm	1000 ppm	
	Hg	5 ppb	50000 ppb	
	K	0.01 %	10 %	
	La	0.5 ppm	10000 ppm	
	Mg	0.01 %	30 %	
	Mn	1 ppm	10000 ppm	
	Mo	0.01 ppm	2000 ppm	
	Na	0.001 %	5 %	
	Ni	0.1 ppm	10000 ppm	
	P	0.001 %	5 %	
	Pb	0.01 ppm	10000 ppm	
	S	0.02 %	10 %	
	Sb	0.02 ppm	2000 ppm	
	Sc	0.1 ppm	100 ppm	
	Se	0.1 ppm	100 ppm	
	Sr	0.5 ppm	2000 ppm	
	Te	0.02 ppm	1000 ppm	
	Th	0.1 ppm	2000 ppm	
	Ti	0.001 %	5 %	
	Tl	0.02 ppm	1000 ppm	
	U	0.1 ppm	2000 ppm	
	V	1 ppm	10000 ppm	
	W	0.1 ppm	100 ppm	
	Zn	0.1 ppm	10000 ppm	
+ PGM	Pt Pd, add-on			\$2.45

*Detection limit = 1 ppm for 15/30 g analysis.

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD
AQ250-EXT	Extended Pkg, 53 elements, 0.5 g			\$25.80
AQ251-EXT	Extended Pkg, 53 elements, 15 g			\$30.55
AQ252-EXT	Extended Pkg, 53 elements, 30 g			\$35.30
	Be	0.1 ppm	1000 ppm	
	Ce	0.1 ppm	2000 ppm	
	Cs	0.02 ppm	2000 ppm	
	Ge	0.1 ppm	100 ppm	
	Hf	0.02 ppm	1000 ppm	
	In	0.02 ppm	1000 ppm	
	Li	0.1 ppm	2000 ppm	
	Nb	0.02 ppm	2000 ppm	
	Pd	10 ppb	100000 ppb	
	Pt	2 ppb	100000 ppb	
	Rb	0.1 ppm	2000 ppm	
	Re	1 ppb	10000 ppb	
	Sn	0.1 ppm	100 ppm	
	Ta	0.05 ppm	2000 ppm	
	Y	0.01 ppm	2000 ppm	
	Zr	0.1 ppm	2000 ppm	

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD
+ REE	Rare Earth, add-on			\$7.25
	Dy	0.02 ppm	2000 ppm	
	Er	0.02 ppm	2000 ppm	
	Eu	0.02 ppm	2000 ppm	
	Gd	0.02 ppm	2000 ppm	
	Ho	0.02 ppm	2000 ppm	
	Lu	0.02 ppm	2000 ppm	
	Nd	0.02 ppm	2000 ppm	
	Pr	0.02 ppm	2000 ppm	
	Sm	0.02 ppm	2000 ppm	
	Tb	0.02 ppm	2000 ppm	
	Tm	0.02 ppm	2000 ppm	
	Yb	0.02 ppm	2000 ppm	
+ ISO	Lead Isotope, add-on			\$14.90

Multi-Acid

Multi-acid digestion packages are capable of dissolving most minerals. We offer a choice of ICP-ES (MA300), ICP-ES/MS (MA200) or Ultra-trace ICP-ES/MS (MA250) analysis to give near total values for most elements. A 0.25 g split is heated in HNO₃, HClO₄ and HF to fuming and taken to dryness. The residue is dissolved in HCl.

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD
MA300	Multi-Acid ICP-ES, 35 elements, 0.25 g			\$15.05
	Ag	0.5 ppm	200 ppm	
	Al	0.01 %	20 %	
	As	5 ppm	10000 ppm	
	Ba	1 ppm	10000 ppm	
	Be	1 ppm	1000 ppm	
	Bi	5 ppm	4000 ppm	
	Ca	0.01 %	40 %	
	Cd	0.4 ppm	4000 ppm	
	Co	2 ppm	4000 ppm	
	Cr	2 ppm	10000 ppm	
	Cu	2 ppm	10000 ppm	
	Fe	0.01 %	60 %	
	K	0.01 %	10 %	
	La	2 ppm	2000 ppm	
	Mg	0.01 %	30 %	
	Mn	5 ppm	10000 ppm	
	Mo	2 ppm	4000 ppm	
	Na	0.01 %	10 %	
	Nb	2 ppm	2000 ppm	
	Ni	2 ppm	10000 ppm	
	P	0.002 %	5 %	
	Pb	5 ppm	10000 ppm	
	S	0.1 %	10 %	
	Sb	5 ppm	4000 ppm	
	Sc	1 ppm	200 ppm	
	Sn	2 ppm	2000 ppm	
	Sr	2 ppm	10000 ppm	
	Th	2 ppm	4000 ppm	
	Ti	0.01 %	10 %	
	U	20 ppm	4000 ppm	
	V	2 ppm	10000 ppm	
	W	4 ppm	200 ppm	
	Y	2 ppm	2000 ppm	
	Zn	2 ppm	10000 ppm	
	Zr	2 ppm	2000 ppm	

AQ200-Hg Aqua Regia ICP-ES/MS, add-on \$13.15

Hg 0.01 ppm 50 ppm

Digestion is partial for some Cr and Ba minerals and oxides of Al, Fe, Hf, Mn, Sn, Ta, Zr and REEs. Volatilization during fuming may result in loss of As, S, Se and Sb.

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD
MA200	Multi-Acid ICP-ES/MS, 45 elements, 0.25 g			\$21.25
	Ag	0.1 ppm	200 ppm	
	Al	0.01 %	20 %	
	As	1 ppm	10000 ppm	
	Ba	1 ppm	10000 ppm	
	Be	1 ppm	1000 ppm	
	Bi	0.1 ppm	4000 ppm	
	Ca	0.01 %	40 %	
	Cd	0.1 ppm	4000 ppm	
	Ce	1 ppm	2000 ppm	
	Co	0.2 ppm	4000 ppm	
	Cr	1 ppm	10000 ppm	
	Cu	0.1 ppm	10000 ppm	
	Fe	0.01 %	60 %	
	Hf	0.1 ppm	1000 ppm	
	In	0.05 ppm	1000 ppm	
	K	0.01 %	10 %	
	La	0.1 ppm	2000 ppm	
	Li	0.1 ppm	2000 ppm	
	Mg	0.01 %	30 %	
	Mn	1 ppm	10000 ppm	
	Mo	0.1 ppm	4000 ppm	
	Na	0.001 %	10 %	
	Nb	0.1 ppm	2000 ppm	
	Ni	0.1 ppm	10000 ppm	
	P	0.001 %	5 %	
	Pb	0.1 ppm	10000 ppm	
	Rb	0.1 ppm	2000 ppm	
	Re	0.005 ppm	100 ppm	
	S	0.1 %	10 %	
	Sb	0.1 ppm	4000 ppm	
	Sc	1 ppm	200 ppm	
	Se	1 ppm	1000 ppm	
	Sn	0.1 ppm	2000 ppm	
	Sr	1 ppm	10000 ppm	
	Ta	0.1 ppm	2000 ppm	
	Te	0.5 ppm	1000 ppm	
	Th	0.1 ppm	4000 ppm	
	Ti	0.001 %	10 %	
	Tl	0.5 ppm	10000 ppm	
	U	0.1 ppm	4000 ppm	
	V	4 ppm	10000 ppm	
	W	0.1 ppm	200 ppm	
	Y	0.1 ppm	2000 ppm	
	Zn	1 ppm	10000 ppm	
	Zr	0.1 ppm	2000 ppm	

AQ200-Hg Aqua Regia ICP-ES/MS, add-on \$13.15

Hg 0.01 ppm 50 ppm

Digestion is partial for some Cr and Ba minerals and oxides of Al, Fe, Hf, Mn, Sn, Ta, Zr and REEs. Volatilization during fuming may result in loss of As, S, Se and Sb.

ULTRA-TRACE BY ICP-ES/MS

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD
MA250	Ultra-trace ICP-ES/MS, 59 elements, 0.25 g			\$28.45
	Ag	20 ppb	200000 ppb	
	Al	0.01 %	20 %	
	As	0.2 ppm	10000 ppm	
	Ba	1 ppm	10000 ppm	
	Be	1 ppm	1000 ppm	
	Bi	0.04 ppm	4000 ppm	
	Ca	0.01 %	40 %	
	Cd	0.02 ppm	4000 ppm	
	Ce	0.02 ppm	2000 ppm	
	Co	0.2 ppm	4000 ppm	
	Cr	1 ppm	10000 ppm	
	Cs	0.1 ppm	2000 ppm	
	Cu	0.1 ppm	10000 ppm	
	Dy	0.1 ppm	2000 ppm	
	Er	0.1 ppm	2000 ppm	
	Eu	0.1 ppm	2000 ppm	
	Fe	0.01 %	60 %	
	Ga	0.02 ppm	100 ppm	
	Gd	0.1 ppm	2000 ppm	
	Hf	0.02 ppm	1000 ppm	
	Ho	0.1 ppm	2000 ppm	
	In	0.01 ppm	1000 ppm	
	K	0.01 %	10 %	
	La	0.1 ppm	2000 ppm	
	Li	0.1 ppm	2000 ppm	
	Lu	0.1 ppm	2000 ppm	
	Mg	0.01 %	30 %	
	Mn	1 ppm	10000 ppm	
	Mo	0.05 ppm	4000 ppm	
	Na	0.001 %	10 %	
	Nb	0.04 ppm	2000 ppm	
	Nd	0.1 ppm	2000 ppm	
	Ni	0.1 ppm	10000 ppm	
	P	0.001 %	5 %	
	Pb	0.02 ppm	10000 ppm	
	Pr	0.1 ppm	2000 ppm	
	Rb	0.1 ppm	2000 ppm	
	Re	0.002 ppm	100 ppm	
	S	0.04 %	10 %	
	Sb	0.02 ppm	4000 ppm	
	Sc	0.1 ppm	200 ppm	
	Se	0.3 ppm	1000 ppm	
	Sm	0.1 ppm	2000 ppm	
	Sn	0.1 ppm	2000 ppm	
	Sr	1 ppm	10000 ppm	
	Ta	0.1 ppm	2000 ppm	
	Tb	0.1 ppm	2000 ppm	
	Te	0.05 ppm	1000 ppm	
	Th	0.1 ppm	4000 ppm	
	Ti	0.001 %	10 %	
	Tl	0.05 ppm	10000 ppm	
	Tm	0.1 ppm	2000 ppm	
	U	0.1 ppm	4000 ppm	
	V	2 ppm	10000 ppm	
	W	0.1 ppm	200 ppm	
	Y	0.1 ppm	2000 ppm	
	Yb	0.1 ppm	2000 ppm	
	Zn	0.2 ppm	10000 ppm	
	Zr	0.2 ppm	2000 ppm	
AQ200-Hg	Aqua Regia ICP-ES/MS, Add-on			\$13.15
	Hg	0.01 ppm	50 ppm	

Digestion is partial for some Cr and Ba minerals and oxides of Al, Fe, Hf, Mn, Sn, Ta, Zr and REEs. Volatilization during fuming may result in loss of As, S, Se and Sb.

Low Grade Ore Analysis

The following multi-element assays provide an expanded range of analysis by combining the geochemical analysis MA200 and AQ200 with the upper limit precision of the assay packages MA370 and AQ370. AQ270 and MA270 combine both ICP-ES and ICP-MS analysis to extend the upper limits and provide a broader spectrum of elements. Intended use of this package is for exploration not resource calculations.

AQUA REGIA ICP-ES/MS

Same digestion as AQ370 but uses both ICP-ES and ICP-MS to expand the detection limits and increase the number of elements analyzed.

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD
AQ270	Aqua Regia ICP-ES/MS, 34 elements			\$25.30
	Ag	0.5 ppm	1000 ppm	
	Al	0.01 %	40 %	
	As	5 ppm	100000 ppm	
	Ba	5 ppm	5000 ppm	
	Bi	0.5 ppm	10000 ppm	
	Ca	0.01 %	40 %	
	Cd	0.5 ppm	10000 ppm	
	Co	0.5 ppm	10000 ppm	
	Cr	0.5 ppm	50000 ppm	
	Cu	0.5 ppm	100000 ppm	
	Fe	0.01 %	40 %	
	Ga	5 ppm	5000 ppm	
	Hg	0.05 ppm	10000 ppm	
	K	0.01 %	40 %	
	La	0.5 ppm	50000 ppm	
	Mg	0.01 %	40 %	
	Mn	5 ppm	200000 ppm	
	Mo	0.5 ppm	50000 ppm	
	Na	0.01 %	25 %	
	Ni	0.5 ppm	100000 ppm	
	P	0.001 %	25 %	
	Pb	0.5 ppm	40000 ppm	
	S	0.05 %	30 %	
	Sb	0.5 ppm	50000 ppm	
	Sc	0.5 ppm	500 ppm	
	Se	2 ppm	500 ppm	
	Sr	5 ppm	10000 ppm	
	Th	0.5 ppm	10000 ppm	
	Ti	0.001 %	10 %	
	Tl	0.5 ppm	5000 ppm	
	U	0.5 ppm	10000 ppm	
	V	10 ppm	50000 ppm	
	W	0.5 ppm	10000 ppm	
	Zn	5 ppm	200000 ppm	

Requires at least 2 g per sample.

MULTI-ACID ICP-ES/MS

Same digestion as MA370 but includes ICP-ES and ICP-MS analysis.

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD
MA270	Multi-acid ICP-ES/MS, 41 elements			\$30.80
	Ag	0.5 ppm	1500 ppm	
	Al	0.01 %	40 %	
	As	5 ppm	100000 ppm	
	Ba	5 ppm	50000 ppm	
	Be	5 ppm	5000 ppm	
	Bi	0.5 ppm	20000 ppm	
	Ca	0.01 %	50 %	
	Cd	0.5 ppm	20000 ppm	
	Ce	5 ppm	10000 ppm	
	Co	1 ppm	20000 ppm	
	Cr	1 ppm	50000 ppm	
	Cu	0.5 ppm	100000 ppm	
	Fe	0.01 %	60 %	
	Hf	0.5 ppm	5000 ppm	
	K	0.01 %	40 %	
	La	0.5 ppm	10000 ppm	
	Li	0.5 ppm	10000 ppm	
	Mg	0.01 %	40 %	
	Mn	5 ppm	200000 ppm	
	Mo	0.5 ppm	50000 ppm	
	Na	0.01 %	25 %	
	Nb	0.5 ppm	10000 ppm	
	Ni	0.5 ppm	100000 ppm	
	P	0.01 %	25 %	
	Pb	0.5 ppm	100000 ppm	
	Rb	0.5 ppm	10000 ppm	
	S	0.05 %	30 %	
	Sb	0.5 ppm	10000 ppm	
	Sc	1 ppm	1000 ppm	
	Se	5 ppm	5000 ppm	
	Sn	0.5 ppm	10000 ppm	
	Sr	5 ppm	10000 ppm	
	Ta	0.5 ppm	2000 ppm	
	Th	0.5 ppm	20000 ppm	
	Ti	0.001 %	10 %	
	U	0.5 ppm	20000 ppm	
	V	10 ppm	50000 ppm	
	W	0.5 ppm	10000 ppm	
	Y	0.5 ppm	5000 ppm	
	Zn	5 ppm	400000 ppm	
	Zr	0.5 ppm	10000 ppm	

Digestion is partial for some Cr and Ba minerals and oxides of Al, Fe, Hf, Mn, Sn, Ta, Zr and REEs. Volatilization during fuming may result in loss of As, S, Se and Sb.

Vegetation Analysis

We offer two types of vegetation preparations depending on the elements of interest and application of the results. The first is an aqua regia digestion on the raw material. This method is best where volatile elements such as As, Se, and Hg are of interest. The second type of preparation involves the ashing of plant material followed by aqua regia digestion. Ashing is effectively a preconcentration step that allows for the detection of low level precious metals that would otherwise be below instrument detection.

PREPARATION

For dry plant material free of any soil. Importation permits may apply; contact the laboratory prior to shipment.

CODE	DESCRIPTION	CAD
DISPL	Dispose of pulps	\$0.20
SVRJT	Saving all or part of reject fraction	\$1.10
VA475	Ashing 50 g dry vegetation at 475°C	\$9.90
VGMAS	Dry and macerate vegetation, per 100 g	\$9.95
VGWSH	Wash plant samples with demineralized water, dry at 60°C, per 100 g	\$3.35
WGHT	Weigh samples	\$0.75

PLANT MATERIAL ANALYSIS

Analysis of vegetation samples using a 1g or 5g split digested in HNO₃ then aqua regia and analyzed by ICP-MS for ultra low detection limits. Washing with demineralized water is recommended if samples are coated with inorganic material. (See VGWSH above).

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD
VG101	Dry Vegetation ICP-MS, 37 elements, 1 g						\$28.05
VG105	Dry Vegetation ICP-MS, 37 elements, 5 g						\$31.70
	Ag	2 ppb	100000 ppb	Mo	0.01 ppm	2000 ppm	
	Al	0.01 %	10 %	Na	0.01 %	5 %	
	As	0.1 ppm	10000 ppm	Ni	0.1 ppm	10000 ppm	
	Au	0.2 ppb	100000 ppb	P	0.001 %	5 %	
	B	1 ppm	2000 ppm	Pb	0.01 ppm	10000 ppm	
	Ba	0.1 ppm	10000 ppm	S	0.05 %	10 %	
	Bi	0.02 ppm	2000 ppm	Sb	0.02 ppm	2000 ppm	
	Ca	0.01 %	40 %	Sc	0.1 ppm	100 ppm	
	Cd	0.01 ppm	2000 ppm	Se	0.1 ppm	100 ppm	
	Co	0.01 ppm	2000 ppm	Sr	0.5 ppm	2000 ppm	
	Cr	0.1 ppm	10000 ppm	Te	0.02 ppm	1000 ppm	
	Cu	0.01 ppm	10000 ppm	Th	0.1 ppm	2000 ppm	
	Fe	0.001 %	40 %	Ti	10 ppm	50000 ppm	
	Ga	0.1 ppm	1000 ppm	Tl	0.02 ppm	1000 ppm	
	Hg	1 ppb	50000 ppb	U	0.01 ppm	2000 ppm	
	K	0.01 %	10 %	V	2 ppm	10000 ppm	
	La	0.01 ppm	10000 ppm	W	0.1 ppm	100 ppm	
	Mg	0.001 %	30 %	Zn	0.1 ppm	10000 ppm	
	Mn	1 ppm	10000 ppm				
+ REE	Rare Earth, add-on						\$7.25
+ PGM	Pt Pd, add-on						\$2.45
+ ISO	Lead Isotope, add-on						\$14.90
VG104	Ash Ultra-trace ICP-MS, 36 elements, 0.5 g (same elements & detection limits as AQ250 excluding Hg , p.25)						\$22.05
VG104-EXT	Ash Extended suite, 52 elements, 0.5 g						\$25.80



CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD
VG101-EXT	Dry Extended suite, 53 elements, 1 g			\$31.80
VG105-EXT	Dry Extended suite, 53 elements, 5 g			\$35.45
	Be	0.1 ppm	1000 ppm	
	Ce	0.1 ppm	2000 ppm	
	Cs	0.02 ppm	2000 ppm	
	Ge	0.01 ppm	100 ppm	
	Hf	0.001 ppm	1000 ppm	
	In	0.02 ppm	1000 ppm	
	Li	0.01 ppm	2000 ppm	
	Nb	0.01 ppm	2000 ppm	
	Pd	2 ppb	100000 ppb	
	Pt	1 ppb	100000 ppb	
	Rb	0.1 ppm	2000 ppm	
	Re	1 ppb	10000 ppb	
	Sn	0.02 ppm	100 ppm	
	Ta	0.001 ppm	2000 ppm	
	Y	0.001 ppm	2000 ppm	
	Zr	0.01 ppm	2000 ppm	
+ ISO	Lead Isotope, add-on			\$14.90

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD
+ REE	Rare Earth elements			\$7.25
	Dy	0.02 ppm	2000 ppm	
	Er	0.02 ppm	2000 ppm	
	Eu	0.02 ppm	2000 ppm	
	Gd	0.02 ppm	2000 ppm	
	Ho	0.02 ppm	2000 ppm	
	Lu	0.02 ppm	2000 ppm	
	Nd	0.02 ppm	2000 ppm	
	Pr	0.02 ppm	2000 ppm	
	Sm	0.02 ppm	2000 ppm	
	Tb	0.02 ppm	2000 ppm	
	Tm	0.02 ppm	2000 ppm	
	Yb	0.02 ppm	2000 ppm	

GENERATIVE EXPLORATION PACKAGE

This package has been designed to provide a suite of elements common in rocks associated with hydrothermal systems. It represents excellent value for applications where only ore forming elements are of interest.

CODE	ELEM	DESCRIPTION	CAD
GENX10	Suite of elements common in rocks associated with hydrothermal systems		\$27.65
	Au	0.005 – 10 ppm	Au determined by FA430 (30 g Fire Assay/AAS finish) Hg determined by Cold Vapour/AA or ICP-MS All other elements determined by AR Digest with ICP analysis
	Ag	0.1 – 100 ppm	
	As	5 – 10,000 ppm	
	Bi	2 – 10,000 ppm	
	Cu	1 – 10,000 ppm	
	Pb	2 – 10,000 ppm	
	Hg	0.01 – 100 ppm	
	Mo	1 – 10,000 ppm	
	Sb	2 – 10,000 ppm	
	Zn	2 – 10,000 ppm	

This package combines both of our ultra-trace packages.

CODE	DESCRIPTION	CAD
GEO05	MA250 + AQ250 (7 elements: As, Au, Hg, Sb, Se, Te, Tl)	\$45.45
+ Au	Fire Assay (FA430: 30 g Fire Assay/AAS finish), add-on	\$15.55

SELECTIVES LEACHES

Selective or sequential extractions can target elements held in a specific soil phase or a range of phases thus allowing better interpretation of ion mobility and geochemical processes. Used sequentially, the leaches can determine whether elements in soils are present as salts, adsorbed to clay minerals, adsorbed/complexed with organics, or associated with amorphous Mn and Fe hydroxides. Used separately, the stronger leaches are less selective.

CODE	DESCRIPTION	CAD
	Separate leach, per leach	\$32.35
	Sequential leach, per leach	\$40.90
	Setup, per leach on submissions of <35 samples	\$341.25
	Report pH	+ \$10.20
LH101	Demineralized water soluble components	
LH102	1 M Ammonium acetate - exchangeable cations adsorbed by clay and elements co-precipitated with carbonates	
LH103	0.1 M Sodium pyrophosphate - elements adsorbed by organic matter (humic and fulvic compounds)	
LH104	0.1 M Hydroxylamine - elements adsorbed by amorphous Mn hydroxide, often the most reactive soil phase for scavenging mobile elements	
LH105	0.25 M Hydroxylamine - elements adsorbed by amorphous Fe hydroxide and more crystalline Mn hydroxide	
LH107	Ammonium nitrate leach estimates metal bioavailability and involves the extraction of weakly bound mobile base metals, alkali, alkaline earth, and Al ions. Can also be used for estimation of cation-exchange capacity (separate leach only).	

OTHER CHARGES

CODE	DESCRIPTION	CAD
EN004	Environmental fee charge	\$0.90



ANALYSIS OF NATURAL WATERS ICP-MS

Surface and groundwater surveys are an effective means for exploration of remote and blind ore deposits. Method SO200 (analysis by ICP-MS) provides the low detection limits needed to define background and anomalous levels of cations in natural water. For this analysis, all water samples must have less than 0.1% total dissolved solids (TDS). This method is not suitable for brines or processed solutions. Water samples with greater than 0.1% total dissolved solids will report a reduced element suite with elevated detection limits.

Analysis of water geochemical parameters, including pH, electrical conductivity, alkalinity, and anions, provides the necessary parameters for complete characterization of water samples. Complete water characterization allows for the determination of not only the type of water (i.e., CaSO₄ or NaCl), but how the type of water relates to ore deposit pathfinder elements. This package is not suitable for environmental surveys.

CODE	ELEM	DETECTION LIMIT	ELEM	DETECTION LIMIT	CAD
SO200*	Full Suite - Cations, 50 ml				\$34.55
	Ag	0.05 ppb	Na	0.05 ppm	
	Al	1 ppb	Nb	0.01 ppb	
	As	0.5 ppb	Nd	0.01 ppb	
	Au	0.05 ppb	Ni	0.2 ppb	
	B	5 ppb	P	10 ppb	
	Ba	0.05 ppb	Pb	0.1 ppb	
	Be	0.05 ppb	Pd	0.2 ppb	
	Bi	0.05 ppb	Pr	0.01 ppb	
	Br	5 ppb	Pt	0.01 ppb	
	Ca	0.05 ppm	Rb	0.01 ppb	
	Cd	0.05 ppb	Re	0.01 ppb	
	Ce	0.01 ppb	Rh	0.01 ppb	
	Cl	1 ppm	Ru	0.05 ppb	
	Co	0.02 ppb	S	1 ppm	
	Cr	0.5 ppb	Sb	0.05 ppb	
	Cs	0.01 ppb	Sc	1 ppb	
	Cu	0.1 ppb	Se	0.5 ppb	
	Dy	0.01 ppb	Si	40 ppb	
	Er	0.01 ppb	Sm	0.02 ppb	
	Eu	0.01 ppb	Sn	0.05 ppb	
	Fe	10 ppb	Sr	0.01 ppb	
	Ga	0.05 ppb	Ta	0.02 ppb	
	Gd	0.01 ppb	Tb	0.01 ppb	
	Ge	0.05 ppb	Te	0.05 ppb	
	Hf	0.02 ppb	Th	0.05 ppb	
	Hg	0.1 ppb	Ti	10 ppb	
	Ho	0.01 ppb	Tl	0.01 ppb	
	In	0.01 ppb	Tm	0.01 ppb	
	K	0.05 ppm	U	0.02 ppb	
	La	0.01 ppb	V	0.2 ppb	
	Li	0.1 ppb	W	0.02 ppb	
	Lu	0.01 ppb	Y	0.01 ppb	
	Mg	0.05 ppm	Yb	0.01 ppb	
	Mn	0.05 ppb	Zn	0.5 ppb	
	Mo	0.1 ppb	Zr	0.02 ppb	

*Samples for SO200, SO001, SO002 and SO003 must be submitted in separate bottles and require at least 50 ml per sample.



Contact us for quote

CODE	ELEM	DETECTION LIMIT
SO001*	Per element , 100 ml*	
	Cl	0.5 mg/L
	SO₄	0.5 mg/L
	Br	0.4 mg/L
	NO₂	0.01 mg/L
	NO₃	0.01 mg/L
	F	0.01 mg/L
SO002*	pH and EC, 100 ml*	
	pH	0.1 units
	Conductivity	1.0 µS/cm
SO003*	Full Suite CaCO₃, HCO₃⁻, OH⁻, 100 ml*	
	Alkalinity	0.5 mg/L

BRINE ANALYSIS

CODE	
ICPTV-W	ICP-ES/MS analysis for high TDS water samples. Analysis is also applicable for Li-brines.



LITHOGEOCHEMISTRY

Lithochemical methods employ fusion techniques to completely digest most refractory matrices. These methods account for structural water and are the only multi-element methods that provide quantitative determinations for silica. The determinations from these methods are the most suitable for constructing rock classification diagrams, molar element ratios and alteration indices. Determination by ICP-ES, ICP-MS, XRF, and laser ablation options are available to suit almost all elements, concentration ranges, and professional preferences.

Whole Rock Analysis by Lithium Borate Fusion

WHOLE ROCK MAJOR AND MINOR ELEMENTS BY ICP-ES

Lithium borate fusion, a highly aggressive dissolution, is effective for most refractory and resistive mineral phases. When coupled with ICP-ES/MS or XRF analysis, the methods provide excellent determination of the total element content.

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD
LF300	Standard suite of major oxides			\$30.95
	SiO ₂	0.01 %	100 %	
	Al ₂ O ₃	0.01 %	100 %	
	Cr ₂ O ₃	0.002 %	10 %	
	CaO	0.01 %	100 %	
	Fe ₂ O ₃	0.04 %	100 %	
	K ₂ O	0.01 %	100 %	
	MgO	0.01 %	100 %	
	MnO	0.01 %	30 %	
	Na ₂ O	0.01 %	100 %	
	P ₂ O ₅	0.01 %	100 %	
	TiO ₂	0.01 %	10 %	
	Ba	5 ppm	5 %	
	Nb	5 ppm	1,000 ppm	
	Ni	20 ppm	10,000 ppm	
	Sc	1 ppm	10,000 ppm	
	Sr	2 ppm	50,000 ppm	
	Y	3 ppm	50,000 ppm	
	Zr	5 ppm	50,000 ppm	
	LOI	0.1 %	100 %	
	Sum	0.01 %	100 %	
LF300-X	Any 1 element			\$22.05
LF300-EXT	Extended package			\$34.70
	Ce	30 ppm	50 000 ppm	
	Co	20 ppm	10 000 ppm	
	Cu	5 ppm	10 000 ppm	
	Zn	5 ppm	10 000 ppm	

WHOLE ROCK MAJOR AND MINOR ELEMENTS WITH C & S

CODE		CAD
LF302	Major oxides ICP-ES, 20 elements Package including LF300 + TC000 (C & S)	\$46.60
LF302-EXT	Major oxides ICP-ES, Package including LF300-EXT + TC000 (C & S)	\$50.35

TOTAL WHOLE ROCK CHARACTERIZATION

These packages include several methods that have been specifically selected to optimize the recovery of virtually all elements present in a geological sample.

CODE		CAD
LF200	Package including (LF100 + LF302)	\$71.00
LF202	Package including (LF100-EXT + LF302)	\$82.60
LF600*	Package including (LF100-EXT + XF700 + TC000)	\$89.75

Requires at least 5 g per sample.

* Requires at least 20 g per sample.

TRACE ELEMENTS BY ICP-MS

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD
LF100	Refractory and Rare Earth elements only			\$32.30
	Ba	1 ppm	50,000 ppm	
	Be	1 ppm	10,000 ppm	
	Ce	0.1 ppm	50,000 ppm	
	Co	0.2 ppm	10,000 ppm	
	Cs*	0.1 ppm	1,000 ppm	
	Dy	0.05 ppm	10,000 ppm	
	Er	0.03 ppm	10,000 ppm	
	Eu	0.02 ppm	10,000 ppm	
	Ga	0.5 ppm	10,000 ppm	
	Gd	0.05 ppm	10,000 ppm	
	Hf	0.1 ppm	10,000 ppm	
	Ho	0.02 ppm	10,000 ppm	
	La	0.1 ppm	50,000 ppm	
	Lu	0.01 ppm	10,000 ppm	
	Nb*	0.1 ppm	1,000 ppm	
	Nd	0.3 ppm	10,000 ppm	
	Pr	0.02 ppm	10,000 ppm	
	Rb*	0.1 ppm	1,000 ppm	
	Sm	0.05 ppm	10,000 ppm	
	Sn	1 ppm	10,000 ppm	
	Sr	0.5 ppm	50,000 ppm	
	Ta*	0.1 ppm	1,000 ppm	
	Tb	0.01 ppm	10,000 ppm	
	Th	0.2 ppm	10,000 ppm	
	Tm	0.01 ppm	10,000 ppm	
	U	0.1 ppm	10,000 ppm	
	V	8 ppm	10,000 ppm	
	W	0.5 ppm	10,000 ppm	
	Y	0.1 ppm	50,000 ppm	
	Yb	0.05 ppm	10,000 ppm	
	Zr	0.1 ppm	50,000 ppm	
LF100-X	Lithium borate fusion ICP-MS, any 1 element			\$22.05
LF100-EXT	Trace elements ICP-MS, 45 elements Package including (LF100 + AQ200)			\$45.15
	Ag	0.1 ppm	100 ppm	
	As	0.5 ppm	10,000 ppm	
	Au	0.5 ppb	100,000 ppb	
	Bi	0.1 ppm	2,000 ppm	
	Cd	0.1 ppm	2,000 ppm	
	Cu	0.1 ppm	10,000 ppm	
	Hg	0.01 ppm	50 ppm	
	Mo	0.1 ppm	2,000 ppm	
	Ni	0.1 ppm	10,000 ppm	
	Pb	0.1 ppm	10,000 ppm	
	Sb	0.1 ppm	2,000 ppm	
	Se	0.5 ppm	100 ppm	
	Tl	0.1 ppm	1,000 ppm	
	Zn	1 ppm	10,000 ppm	

* For higher upper limits on Ta, Nb, Cs, Rb - Request REEPKG
Results for Co, Cu, Ni, Pb and Zn may not be quantitative by this method.

CARBON & SULPHUR ANALYSIS

CODE	DESCRIPTION	DETECTION LIMIT	UPPER LIMIT	CAD
TC000	Leco – C	0.02 %	50 %	\$20.80
	Leco – S	0.02 %	20 %	
	Surcharge samples > 20% (S)	20 %	50 %	+ \$7.60
TC000-C	Leco – Total C	0.02 %	100 %	\$17.70
TC005	Graphite C	0.02 %	20 %	\$34.30
TC006	Inorganic Carbon, (Direct CO ₂ evolution Leco analysis)	0.08 %	100 %	\$20.80
TC007	Organic C (TC000-C, TC005, TC006)	0.02 %	100 %	\$33.00
TC000-S	Leco – Total S	0.02 %	20 %	\$17.70
	Surcharge samples > 20% (S)	20 %	50 %	+ \$7.60
TC008	Sulphate – Leco after ignition	0.15 %	100 %	\$26.00
TC009	Sulphide – (TC000-S, TC008)	0.15 %	100 %	\$27.30
TC508	Sulphate – gravimetric	0.05 %	100 %	\$31.20
TC901	Elemental S	0.01 %	14 %	\$34.30

Requires at least 5 g per sample.

XRF

X-ray fluorescence analysis on fused discs is an excellent method for the determination of whole rock major elements, as well as some minor elements. It is the preferred method for iron ore, bauxite, Ni-laterites, and phosphate ores. Bureau Veritas also offers a specific XRF method for the determination of major elements, plus sub-percent to high-grade Cu, Pb, and Zn ore concentrations.

WHOLE ROCK MAJOR OXIDES

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD
XF700	Standard Package, 15 elements			\$38.20
	SiO ₂	0.01 %	100.0 %	
	Al ₂ O ₃	0.01 %	100.0 %	
	Fe ₂ O ₃	0.01 %	100.0 %	
	CaO	0.01 %	100.0 %	
	MgO	0.01 %	100.0 %	
	Na ₂ O	0.01 %	15.0 %	
	K ₂ O	0.01 %	15.0 %	
	MnO	0.01 %	50.0 %	
	TiO ₂	0.01 %	20.0 %	
	P ₂ O ₅	0.01 %	40.0 %	
	Cr ₂ O ₃	0.01 %	10.0 %	
	Ba	0.01 %	58.8 %	
	LOI	0.1 %	100.0 %	
	SO ₃	0.002 %	10.0 %	
	Sr	0.002 %	1.5 %	
XF702	Standard Package including TC000 (C & S)			\$43.50

Requires at least 12 g per sample.

BAUXITE

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD
XF701	Bauxite Package, 17 elements			\$43.15
	SiO ₂	0.01 %	100.0 %	
	Al ₂ O ₃	0.01 %	100.0 %	
	Fe ₂ O ₃	0.01 %	100.0 %	
	CaO	0.01 %	50.0 %	
	MgO	0.01 %	40.0 %	
	Na ₂ O	0.01 %	8.5 %	
	K ₂ O	0.01 %	15.0 %	
	MnO	0.01 %	50.0 %	
	TiO ₂	0.01 %	10.0 %	
	P ₂ O ₅	0.001 %	40.0 %	
	Cr ₂ O ₃	0.004 %	10.0 %	
	BaO	0.01 %	10.0 %	
	ZnO	0.002 %	1.0 %	
	ZrO ₂	0.01 %	1.5 %	
	V ₂ O ₅	0.002 %	10.0 %	
	SO ₃	0.01 %	3.5 %	
	LOI	0.1 %	100.0 %	

IRON ORE ANALYSIS

Fused discs for XRF analysis provide robust and precise data for all iron ore matrices. Loss On Ignition (LOI) is determined separately at 1000°C. Sample is mixed with lithium tetraborate/metaborate flux followed by fusion and casting into glass discs. Fused discs are entirely homogeneous and eliminate matrix and grain size variability thus presenting an ideal sample to an extremely stable analytical platform. The data produced is of the highest assay quality and is verified with a full spectrum of iron ore specific certified reference materials.

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD
XF732	Iron Ore Standard suite, 11 elements			\$38.20
	SiO ₂	0.01 %	100.0 %	
	Al ₂ O ₃	0.01 %	100.0 %	
	Fe	0.01 %	75.0 %	
	CaO	0.01 %	50.0 %	
	MgO	0.01 %	50.0 %	
	K ₂ O	0.01 %	15.0 %	
	MnO	0.01 %	50.0 %	
	TiO ₂	0.01 %	20.0 %	
	P	0.001 %	10.0 %	
	Cr	0.001 %	10.0 %	
	LOI	0.1 %	100.0 %	
XF732-EXT	Iron Ore Extended suite, 23 elements			\$41.95
	V	0.002 %	5.0 %	
	Ba	0.005 %	10.0 %	
	Ni	0.001 %	8.0 %	
	Co	0.001 %	5.0 %	
	Cu	0.002 %	5.0 %	
	Pb	0.005 %	8.0 %	
	Zn	0.001 %	1.5 %	
	As	0.002 %	1.5 %	
	Sr	0.001 %	3.0 %	
	Zr	0.001 %	1.0 %	
	S	0.001 %	5.0 %	
	Na ₂ O	0.01 %	8.0 %	

Requires at least 12 g per sample weight.

PHOSPHATE ROCK

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD
XF740	Phosphate Rock Package, 11 elements (includes LOI)			\$43.15
	SiO ₂	0.01 %	100.0 %	
	Al ₂ O ₃	0.01 %	100.0 %	
	Fe ₂ O ₃	0.01 %	100.0 %	
	CaO	0.01 %	80.0 %	
	MgO	0.01 %	80.0 %	
	Na ₂ O	0.01 %	15.0 %	
	K ₂ O	0.01 %	15.0 %	
	MnO	0.01 %	50.0 %	
	TiO ₂	0.01 %	40.0 %	
	P ₂ O ₅	0.01 %	40.0 %	
	LOI	0.1 %	100.0 %	

XRF FOR BASE METAL BEARING SAMPLES

In addition to commonly reported major elements such as oxides, this XRF method also reports Cu, Pb, and Zn concentrations. The benefit of base metal determination by Li-borate fusion/XRF are the dynamic concentration ranges achievable, plus the absence of potential recovery issues that may exist with acid digestions where sulphur contents are high.

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD
LF725	Base Metals bearing Package, 16 elements (includes LOI)			\$39.80
	SiO ₂	0.01 %	100.0 %	
	Al ₂ O ₃	0.01 %	100.0 %	
	Fe ₂ O ₃	0.01 %	100.0 %	
	CaO	0.01 %	100.0 %	
	MgO	0.01 %	100.0 %	
	K ₂ O	0.01 %	15.0 %	
	MnO	0.01 %	50.0 %	
	TiO ₂	0.01 %	50.0 %	
	P ₂ O ₅	0.01 %	40.0 %	
	Cr ₂ O ₃	0.01 %	10.0 %	
	Ba	0.01 %	58.8 %	
	Cu*	0.01 %	8.0 %	
	Pb*	0.01 %	25.0 %	
	Zn*	0.01 %	24.0 %	
	LOI	0.1 %	100.0 %	

*Over limit analysis up to 40% Cu; 75% Pb; 60% Zn.

Nickel Laterite Analysis

Exploration and evaluation of nickel laterite requires total determination and mass balance accounting of the major rock-forming elements and the commodity elements Ni, Cu and Co. BVM delivers these requirements by XRF or laser ablation.

LATERITE STANDARD SUITE BY XRF

This package uses a predetermined amount of sample dried at 105°C to remove moisture to ensure that the hygroscopic nature of the material does not add error to the analysis. A test portion of that dried material is then fused in a platinum gold crucible with a lithium tetraborate flux and cast into a disc. Fused discs are analyzed by XRF. Another test portion of dried sample is roasted at 1000°C to determine the loss on ignition.

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD
XF720	Laterite Standard suite by XRF, 15 elements			\$43.15
	SiO ₂	0.01 %	100.0 %	
	Al ₂ O ₃	0.01 %	100.0 %	
	Fe ₂ O ₃	0.01 %	100.0 %	
	CaO	0.01 %	50.0 %	
	MgO	0.01 %	50.0 %	
	K ₂ O	0.005 %	15.0 %	
	MnO	0.002 %	50.0 %	
	TiO ₂	0.01 %	10.0 %	
	P ₂ O ₅	0.001 %	15.0 %	
	Cr ₂ O ₃	0.005 %	6.8 %	
	Ni	0.002 %	7.5 %	
	Co	0.001 %	3.5 %	
	Cu	0.002 %	8.0 %	
	Zn	0.001 %	1.5 %	
	LOI	0.1 %	100.0 %	

XF722 Laterite Package including TC000 (C & S) **\$49.15**

Laterite analytical methods incorporate special handling procedures to minimize moisture accumulation due to the hygroscopic nature of the material. Please contact us if you are interested in using other analytical methods not listed here for laterites.

XRF SPECIFIC ELEMENTS BY FUSION

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD
XF750-X	High Grade Tin and Tungsten Package for the first element			\$20.75
	SnO ₂	0.01 %	35.0 %	
	WO ₃	0.01 %	50.0 %	
	Additional element			\$4.10

CODE	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD
LF700-X	High Grade Cesium Package for the first element			\$19.65
	Cs	0.01 %	30.0 %	
	Additional element			by quote



Laser Ablation Packages

This package utilizes state-of-the-art laser ablation and ICP-MS instrumentation to analyze the fused glass disk from a Li-borate fusion digestion. It can be coupled with wavelength dispersive XRF to provide a complete total whole rock analysis.



- Lower detection limits are comparable to traditional acid digestion methods.
- XRF and LA-ICP-MS capabilities can be combined to extend the dynamic range, which removes the need for overlimit analyses (i.e., Sn from 0.2 ppm to percent level).
- Simplification of the analytical process (only 1 digestion needed for major and trace whole rock characterization).
- Safety and environmental advantages - there are no acids used in digestion.

FUSED BEAD LASER ABLATION ICP-MS

CODE	ELEM	DETECTION LIMIT	CAD
LA001	Basic package, 34 elements		\$39.45
	Ag	0.01 ppm	
	As*	0.2 ppm	
	Ba	0.5 ppm	
	Be	0.2 ppm	
	Bi	0.2 ppm	
	Cd*	0.1 ppm	
	Ce	0.002 ppm	
	Co	0.1 ppm	
	Cr	1 ppm	
	Cs	0.01 ppm	
	Cu	2 ppm	
	Ga	0.1 ppm	
	Hf	0.01 ppm	
	In	0.05 ppm	
	La	0.01 ppm	
	Mn	1 ppm	
	Mo	0.2 ppm	
	Nb	0.01 ppm	
	Ni	2 ppm	
	Pb	1 ppm	
	Sb*	0.1 ppm	
	Sc	0.1 ppm	
	Sn	0.2 ppm	
	Sr	0.1 ppm	
	Ta	0.01 ppm	
	Te	0.2 ppm	
	Th	0.01 ppm	
	Ti	1 ppm	
	U	0.01 ppm	
	V	0.1 ppm	
	W	0.05 ppm	
	Y	0.02 ppm	
	Zn	5 ppm	
	Zr	0.5 ppm	

Method is performed at BVM's Perth, Australia facility. Shipping and Australian Customs charges may apply. Ask us about documentation and costs. \$300 minimum charge for service.

* Partially volatilized.

CODE	ELEM	DETECTION LIMIT	CAD
LA001-EXT	Extended package including LA001, 49 elements		\$51.25
	Rb	0.05 ppm	
	Re	0.01 ppm	
	Se*	5 ppm	
	Tl	0.2 ppm	
	Dy	0.01 ppm	
	Er	0.01 ppm	
	Eu	0.01 ppm	
	Gd	0.01 ppm	
	Ho	0.01 ppm	
	Lu	0.01 ppm	
	Nd	0.01 ppm	
	Pr	0.01 ppm	
	Sm	0.01 ppm	
	Tm	0.01 ppm	
	Yb	0.01 ppm	

*Partially volatilized.

CODE	ELEM	DETECTION LIMIT	CAD
+ XRF	Major Oxides Package, Add-on		\$21.55
	Al ₂ O ₃	100 ppm	
	CaO	100 ppm	
	Cl	10 ppm	
	Fe ₂ O ₃	100 ppm	
	K ₂ O	100 ppm	
	MgO	100 ppm	
	MnO	10 ppm	
	Na ₂ O**	100 ppm	
	P ₂ O ₅	10 ppm	
	SO ₃	10 ppm	
	SiO ₂	100 ppm	
	TiO ₂	10 ppm	
	LOI	0.01 %	
	Sum	0.01 %	

** May not be available for some sample types.



METALLURGY & MINERALOGY

Our Metallurgical division offers a full range of services from the early exploration phase through scoping, pre-feasibility and feasibility studies for process development and flowsheet design including larger-scale continuous pilot plant operation. Our experience includes evaluation of precious metals, base metals and industrial minerals, environmental concerns and production aspects, using both conventional and newly developed technologies.

Mineralogical studies are critical to successful geological exploration and the processing of ores. We provide packages including: bulk mineralogical analysis (BMA), particle mineralogical analysis (PMA), trace mineral search (TMS), FieldScan (FS) using QEMSCAN, MLA Express and optical mineralogy for both thin and polished sections.

Mineral Processing

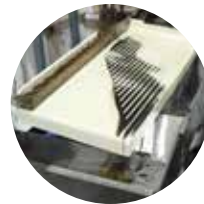


Our Mineral Processing Laboratories are fully equipped to perform all metallurgical investigations from bench scale to demonstration tests. The focus is on developing a practical and economical flow sheet for plant operation, whether it is by adapting known technologies to new situations or by developing a new process.



COMMINUTION

- Crushing
- Grinding
- Starkey SAG Design Test
- Abrasion Index
- Bond Rod & Ball Mill Work Index
- Size Classification & Screening
- Malvern Laser size analysis



GRAVITY CONCENTRATION

- Shaking tables
- Hand panning
- Mozley mineral separator
- Elutriation
- Spirals
- Heavy media cones
- Heavy media separation
- Centrifugal concentrators (Falcon and Knelson)



FLOTATION

- Batch flotation
- Locked-cycle flotation
- Special gas media flotation
- Column flotation
- Reverse & flash flotation
- Agglomeration flotation



MAGNETIC SEPARATION

- Davis Tube
- Drum separator
- Belt separator
- High gradient separator

SOLID-LIQUID SEPARATION

- Standard thickening procedures
- Differential settling
- Vacuum & pressure filtration



Hydrometallurgy

Our laboratory facilities are fully equipped to conduct a wide range of hydrometallurgical and bio-hydrometallurgical studies to recover valuable constituents from concentrates or raw minerals, using methods based on mass chemistry, where one or more of the mineral structures are changed, in an aqueous environment. Previous projects have ranged from the recovery of valuable metals from steel furnace dust, gold and silver extraction from refractory minerals, to heap leaching and solvent extraction of copper. These include the full scale up from individual batch tests through continuous bench tests to commercial sized pilot plant reactors.

Testing capabilities includes:

- Cyanidation studies (Merrill Crowe, CIP and CIL procedures)
- Pressure leaching
- Bottle roll and tank leaching
- Counter current closed circuit tank leaching
- Column leaching up to one meter diameter (8 tonnes)
- Diagnostic / sequential leaching
- Solvent extraction
- Ion exchange
- Electrowinning
- Differential precipitation
- Bio-oxidation of refractory gold ores and concentrates
- Biological leaching of base metal ores and concentrates
- Biological heap leach simulation
- Cyanide and ammonia detoxification
- Galvanox copper recovery process, four-reactor pilot plant with elutriator and thickener



CONTINUOUS GRINDING GRAVITY FLOTATION PILOT PLANT

A complete ore treatment pilot plant, consisting of crushing – continuous grinding - gravity concentration – rougher/cleaner flotation - tailing thickening, can be assembled for any circuit combination, with throughput ranging from 1 to 5 tonnes per day, depending on ore hardness.



BANKABLE FEASIBILITY

Bureau Veritas Minerals is well recognized in the mining industry for value-added input and quality work. The Metallurgical Division is fully qualified to complete “bankability” testing and mill design. Over the past 28 years, our group has provided this level of service to many of the major mining engineering firms working within the mining industry. Our independence, reliability and accountability are firmly established.

Mineralogy and Petrography

Mineralogical studies are critical to successful geological exploration and the processing of ores.



BULK MINERAL ANALYSIS (BMA)

This investigation is a one-dimensional linear analysis of point counting that provides a fast, basic study of mineral department.

- Complete mineral composition and department
- Elemental department
- Mineral association, liberation & grain size

PARTICLE MINERAL ANALYSIS (PMA)

A two-dimensional mapping analysis that provides in-depth data for investigative purposes such as flotation or leaching process.

- Complete mineral composition
- Elemental department
- Mineral liberation and associations by size
- Effect of primary grind on mineral liberation
- Limiting grade recovery curves for the elements of interest

TRACE MINERAL SEARCH (TMS)

TMS is a refinement of the PMA scan but only measures a sub-population of the particles based on a backscattered electron intensity threshold value.

- Target mineral (gold/silver/PGM/Bi/W/Mo) grain size
- Target elemental distribution across bearing minerals
- Mineral grain size and size distribution
- Mineral liberation and association
- Mineral locking characteristics

DIAGNOSIS OF METALLURGICAL PERFORMANCE

Using the combined methods of QEMSCAN/MLA analysis to determine the sources that caused contamination in the final concentrates and the loss of target metals into the tailings in plant operations or metallurgical tests.

- Efficiency of primary grind and regrinding on the target mineral liberations
- The quality of final concentrates
- Status of the target minerals lost into the tailings
- Target mineral recovery by process streams, by mineral association class and by particle size
- Evaluation of potential improvement in the concentrate quality and metal recovery of plant operations or metallurgical test work

X-RAY DIFFRACTION

XRD analysis is an effective, non-destructive method for the determination of sample mineralogy. BVM will provide you with a comprehensive report for each sample analyzed.

Excerpts from General Conditions of Service

Full General Conditions of Service can be found at BVM Website (www.bureauveritas.com/um/services/general-conditions-of-service) and that you acting on behalf of the Client accept the General Conditions of Service. "The Company" is the legal entity with whom the Client is providing instructions.

1. Technical Services

The Company is an enterprise principally engaged in mineral preparation and laboratory testing services for mining, minerals exploration and research, as such it carries out laboratory analysis or other testing related to Exploration and Mining, supply of technicians or other personnel related to Exploration and Mining.

2. Instructions

The Company will provide services in accordance with the Client's specific instructions as accepted and confirmed by the Company so far as such testing methods as the Company shall deem appropriate in its detection limit and confidence interval. All enquiries and orders for the supply of services must be accompanied by sufficient information, specifications and instructions to enable the Company to evaluate and/or perform the services required. The client to inform the Company in advance of any known hazards or dangers, actual or potential, associated with any order or samples or testing including, for example, presence or risk of radiation, toxic or noxious or explosive elements or materials, environmental pollution or poisons. The client will be liable for cost of disposal of samples considered hazardous or dangerous.

3. Reports

Subject to the Client's instructions as accepted by the Company, the Company will issue reports which reflect statements of opinion made with due care within the limitation of instructions received but the Company is under no obligation to refer to or report upon any facts or circumstances which are outside the specific instructions received. Reports issued following testing or analysis of such samples as are submitted to the Company for analysis (but not drawn from the bulk by the Company) contain the Company's specific opinion on those samples only but do not express or imply any opinion upon the bulk from which the samples were drawn. The Company will not be liable the Client or any third party for any samples so altered, lost, damaged or destroyed.

4. Limitation of Liability

The Company undertakes to exercise due care and skill in the performance of its services and accepts responsibility only where such skill and care is not exercised and negligence against the Company is proven.

The liability of the Company in respect of any claims for loss, damage or expense of whatsoever nature and howsoever arising in respect of any breach of contract and/or any failure to exercise due skill and care by the Company shall in no circumstances exceed a total aggregate sum equal to the amount of the fee in respect of the specific service required under the particular contract with the Company which gives rise to such claims.

5. Payment Terms

The Client will punctually pay not later than 30 (thirty) days after the relevant invoice date (or within such other period as may have been agreed in writing by the Company) all proper charges rendered by the Company failing which, and without prejudice to any other rights or remedies available to the Company, interest will become due at the rate of 15 (fifteen) per cent per annum from the date of invoice until payment.

All prices quoted and charges due under these General Conditions shall, unless the Company confirms otherwise in writing, be exclusive of any value added or sales tax which shall be charged in addition at the prevailing rate. In the event of any suspension of payment, arrangement with creditors, bankruptcy, insolvency, receivership or cessation of business by the Client the Company shall be entitled to suspend all further performance of its services forthwith and without liability and all sums payable to the Company shall become immediately due and payable. Company may withhold results or services due to nonpayment or credit terms not granted/revoked.

6. Confidentiality

Neither party shall disclose information identified as confidential to anyone except those individuals who need such information to perform the Services; nor should either party use such confidential information, except in connection with the Work, the performance of the Services or as authorized by the other party in writing. The technical and pricing information contained in any proposal or other documents submitted to Client by Company is to be considered confidential and proprietary and shall not be released or disclosed to a third party without Company's written consent.

7. Relationship of Parties

Company is an independent company, and nothing contained herein shall be construed as constituting any other relationship with Client, nor shall it be construed as creating any relationship whatsoever between Client and Company's employees. Company has sole authority and responsibility to hire, fire and otherwise control its employees, and neither Company nor any of its employees are employees of Client.

8. Third Party Beneficiaries

It is expressly understood and agreed that the enforcement of these terms and conditions shall be reserved to the Client and Company. Nothing contained in the agreement shall give or allow any claim or right of action whatsoever by any third person.

9. Re-use

If the Client re-uses, modifies or a third party relies on the services, analyses, reports or certifications without Company's written permission, then Client agrees to defend and indemnify Company from any claims or actions that are brought and any costs, damages, expenses or liabilities, including reasonable attorneys' fees, arising out of or related to such reliance or such re-use or modification.

10. Prevailing Party

In all disputes arising under this Agreement, the parties agree that the prevailing party shall be entitled to recover its reasonable attorney's fees, court costs and other legal expenses from the other party.

11. Force Majeure

Neither Party shall be liable for any delay in delivery or nonperformance in whole of its obligations under this Agreement if prevented from doing so by a cause or causes beyond its control, including, without limitation, acts of God or public enemy, failure of suppliers to perform, fire, floods, storms, earthquakes, riots, strikes, war, and restraints of government.



ENVIRONMENTAL SERVICES

The mining industry relies on timely and reliable data to support important decisions through all stages of a mine's lifecycle, from resource evaluation through to post closure monitoring. Our customers have access to the largest scope of environmental laboratory services supporting the mining sector, including air, soil and water quality testing, environmental chemistry, acid rock drainage, ecotoxicology, radiochemistry as well as many other critical testing services. We help our customers comply with environmental regulations and standards that protect the health and safety of people and the environment. We leverage our decades of local and international project experience to help you reduce your risk and meet or exceed challenges of quality, health and safety, environmental, and social responsibility.

Environmental Chemistry

The characterization of the natural environment is important to evaluating the success of a mine with respect to the various ways it may interact with natural systems. Whether it is through effluent discharge, surface runoff, groundwater seepage, air emissions or deposition of particulate matter, understanding the pre-existing, and various project stage concentrations of environmental variables helps identify potential impacts. Bureau Veritas Group provides a comprehensive suite of environmental tests for the mining sector.

Environmental capabilities include:

- Effluent analysis for regulatory compliance
- Routine water quality monitoring including permit stations, wastewater treatment plants (effluent/influent), tailings pond characterization, and monitoring wells
- Soil and water analysis in support of baseline monitoring projects
- Leachate characterization using TCLP/SPLP in sediment and soil samples
- Ultratrace metals to support aquatic and human health risk assessment
- Ambient air quality and stack testing

WATER TESTING

ANALYSIS	METHOD	CAD
Acidity	Based on SM2310	\$26.25
Alkalinity*	Titration/Electrode	\$26.25
Anions Br, Chloride F, NO ₃ , NO ₂ , PO ₄ , SO ₄ *	Ion Chromatography/ Colourimetry	\$84.00
Ammonia-N*	Colourimetry	\$31.50
BOD ₅ – Total/Carbonaceous	Based on APHA 5210B	\$63.00
BTEX/F1	HS GC/MS, GC/FID	\$94.50
BTEX/F1-F2	HS GC/MS, GC/FID	\$147.00
BTEX/F1-F4	HS GC/MS, GC/FID	\$189.00
F4 Gravimetric (C50+)	Gravimetry	\$52.50
Carbon, Dissolved Organic (DOC)	Based on SM 5310C	\$47.25
Carbon, Total Organic (TOC)	Based on SM 5310C	\$47.25
Chemical Oxygen Demand (COD)	Titration or Colourimetry	\$42.00
Conductivity	Electrode Meter	\$15.75
Cyanide, Strong Acid Dissociable (SAD)	Distillation, Colourimetry	\$36.75
Cyanide, Weak Acid Dissociable (WAD)	Distillation, Colourimetry	\$36.75
Cyanide, Free	Distillation, Colourimetry	\$50.00
EPH, Total (TEH), C10 – C30	GC/FID	\$94.50
Hardness (Ca/Mg by ICP/OES)	ICP, Calculation	\$63.00
Nitrogen, Total	Colourimetry	\$36.75
pH	Electrode Meter	\$15.75
Phosphorus, Total	Colourimetry	\$36.75
Phosphorus, Dissolved*	Colourimetry	\$36.75
Solids, Total Dissolved*	Gravimetric	\$31.50
Solids, Total Suspended*	Gravimetric	\$31.50
Turbidity	Nephelometry	\$26.25

*Low level analysis is available upon request.

SOIL & SEDIMENT TESTING

ANALYSIS	METHOD	CAD
BTEX/F1	HS GC/MS, GC/FID	\$94.50
BTEX/F1-F4	HS GC/MS, GC/FID	\$189.00
F4 Gravimetric (C50+)	Gravimetry	\$52.50
Carbon, Total Organic (TOC)	Based on SM 5310C	\$73.50
Cation Exchange Capacity	BaCl ₂ extn, ICP/OES	\$115.50
C:N Ratio	Combustion	\$194.50
Nitrogen, Total	Colourimetry	\$52.50
Nitrogen, Total Kjeldahl	Digestion, Colourimetry	\$47.25
Organic Matter, Loss on Ignition	Burning and Ashing at 550°C	\$47.25
NPKS Package Nitrogen, Phosphorous, Potassium, and Sulphur	IC, ICP/OES	\$131.25
Particle Size by Sieve	Sieves #4, #10, #40, #200	\$84.00
Salinity Package Soluble EC, pH, Na, Ca, Mg, K, S, Chloride, SO ₄ , Sodium Adsorption Ratio (SAR), Saturation %	Conductivity meter, pH Meter, IC, ICP/OES	\$105.00

Trace Metals



Metals are the driving force behind the majority of mining projects, but it is not only the precious or rare earth metals that need characterization. The additional trace metals that could become contaminants in the environment from the mining process are also a critical consideration to a mine meeting its regulatory commitments. The Bureau Veritas Group employs the latest technology to provide high quality trace metal analysis for the mining industry. Recently, the innovative ICP-MS Triple Quadrupole (ICP/MS-QQQ), has been added to our instrumentation fleet, helping our clients reach the lowest detection limits and most stringent regulatory criteria.

ICP/MS-QQQ WATER TESTING METALS BY CV-AF, ICP/MS & ICP-CRC/MS,

ROUTINE METALS	
Aluminum	Nickel
Antimony	Phosphorus
Arsenic	Potassium
Barium	Selenium
Beryllium	Silica
Bismuth	Silver
Boron	Sodium
Cadmium	Strontium
Calcium	Sulphur
Chromium	Tellurium
Cobalt	Thallium
Copper	Tin
Iron	Titanium
Lead	Tungsten
Lithium	Uranium
Magnesium	Vanadium
Manganese	Zinc
Mercury	Zirconium
Molybdenum	

RARE EARTH METALS
Cerium
Cesium
Dysprosium
Erbium
Europium
Gadolinium
Holmium
Lanthanum
Lutetium
Neodymium
Praseodymium
Samarium
Terbium
Thulium
Ytterbium

PRECIOUS METALS
Gold
Iridium
Palladium
Platinum
Rhenium
Rhodium
Ruthenium

OTHER METALS
Gallium
Lanthanum
Niobium
Rubidium
Scandium
Tantalum



Contact us for quote

Our laboratory has designed analytical packages to meet the MDMER requirements for effluent sampling and Environmental Effects Monitoring (EEM). Contact us for a price quotation.”

Ecotoxicology

Ecotoxicology is essential for evaluating the effects of industrial processes on the environment. Bureau Veritas operates three Ecotoxicology laboratories located in Canada: Quebec City, Edmonton and Burnaby. Our team of experts has over 100 years of combined experience in aquatic toxicity testing. Bureau Veritas strives to be your first choice for routine and customized toxicity testing. We provide services ranging from routine compliance testing to projects requiring customized experimental design and interpretive reporting.



ACUTE AND SUBLETHAL TOXICITY

Bureau Veritas offers freshwater acute toxicity tests for effluent discharge monitoring in aquatic ecosystems (rainbow trout, *Daphnia magna*, threespine stickleback, Microtox®). Sublethal and chronic tests are also offered for Environmental Effects Monitoring of freshwaters including: *Ceriodaphnia dubia*, fathead minnows, algae, *Lemna minor*, and marine species including: Echinoderm fertilization, topsmelt, and *Champia parvula*.



FRESHWATER AND MARINE SEDIMENTS

Bureau Veritas provides effective tools for assessing toxicity sources associated with marine and fresh water sediments (i.e. *Hyalella azetca*, *Chironomus* sp., marine amphipods, *Neanthes* sp., bivalves, and echinoderms). We have considerable experience with testing sediments from contaminated sites or dredged sediments for bioaccumulation potential using organisms such as *Lumbriculus varegatus*, *Macoma nasuta* or *Nereis virens*.

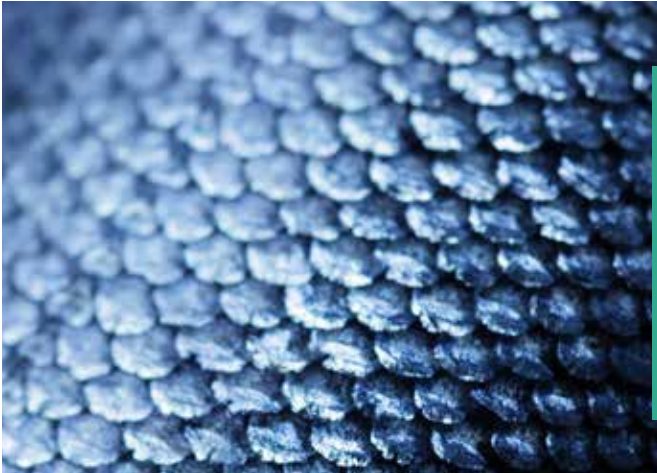
WATER TESTING

ANALYSIS	METHOD	CAD
Daphnia magna 48h Single concentration	EPS 1/RM/14	\$262.50
Daphnia magna 48h LC50	EPS 1/RM/14	\$262.50
Rainbow Trout 96h Single concentration	EPS 1/RM/13	\$367.50
Rainbow Trout 96h LC50	EPS 1/RM/13	\$420.00

FRESHWATER SUBLETHAL/CHRONIC TESTING

ANALYSIS	METHOD	CAD
<i>Ceriodaphnia dubia</i> three brood (dilution series)	EPS 1/RM/21	\$1,890.00
Fathead Minnow 7d growth	EPS 1/RM/22	\$2,016.00
72h Green Algae growth Inhibition	EPS 1/RM/25	\$1,470.00
<i>Lemna minor</i> 7d growth Inhibition (IC25)	EPS 1/RM/37	\$1,312.50

Tissue Analysis



Bureau Veritas performs a wide range of assays on various biota including fruits, plants, mussels, liver and fish. Understanding exposure of aquatic organisms such as fish to contaminants can be an important aspect of describing natural concentrations and the impacts of industrial activities. Metal concentrations in tissue can now be analyzed at ultra-low detection limits, as a result of advancement in instrumentation. Bureau Veritas offers some of the lowest detection limits in Canada, particularly in complex sample matrices.

METALS IN TISSUE CV/AF, ICP/MS, ICP-CRC/MS, ICP/MS-QQQ



TOTAL METALS		
Aluminum	Iron	Silver
Antimony	Lead	Sodium
Arsenic	Lithium	Strontium
Barium	Magnesium	Sulphur
Beryllium	Manganese	Tellurium
Bismuth	Mercury (ICP/MS)	Thallium
Boron	Mercury (CV/AF)	Tin
Cadmium	Molybdenum	Titanium
Calcium	Nickel	Tungsten
Cesium	Phosphorus	Uranium
Chromium	Potassium	Vanadium
Cobalt	Rhodium	Zinc
Copper	Selenium	Zirconium



NON-LETHAL FISH TISSUE ANALYSIS

Following simple and well developed field techniques, non-lethal fish tissue sampling permits fish to be released back into the environment soon after capture and sample collection. The technique involves surgical style removal of a tissue plug from the fish while under sedation, followed by sealing of the wound and immediate release. This technique has allowed stakeholders to introduce corporate policies that reduce lethal fish monitoring as a component of routine monitoring programs, while still meeting the reporting objectives for contaminant loading to the environment. Biopsy kits are available from Bureau Veritas along with the tissue vials to facilitate the sample collection and ensure consistent methodologies.

Acid Rock Drainage



Contact us for quote

Bureau Veritas has participated in the development of acid generation potential testing as well as sulphur speciation to support ARD prediction testing for many years. This testing is used to determine appropriate disposal options and storage for waste rock and tailings to minimize environmental impact.

GENERAL ARD, GEOCHEMICAL & STATIC TESTING

ANALYSIS	METHOD
Sample Preparation (charge per kg)	
ABA Package (Modified NP or Standard Sobek NP) includes paste pH, fizz rating, total sulphur (by Leco), NP, MPA, NNP and NPR)	MEND/EPA
Paste pH or Paste EC (Near Saturation)	MEND
Rinse pH or Rinse EC (Surface Rinse pH on -2mm fraction)	MEND
Sulphate Sulphur (S) by HCl (Sulphide S by difference)	ASTM 2492
Sulphate Sulphur by sodium carbonate extraction	MEND
Sulphur Speciation - sulphate S and sulphide S (includes insoluble S by difference)	ASTM 2492
Sulphate Sulphur by pyrolysis (for insoluble sulphate minerals)	MEND
Inorganic Carbon (CO ₂)	LECO
Total Carbon	LECO
NP (Siderite Correction)	Skoussen
WRA majors using Lithium Borate Fusion	ICP/OES
WRA majors	XRF
Trace Metals	Aqua Regia digestion, ICP/MS 4 Acid Digestion, ICP/MS
Ultratrace Metals	Aqua Regia Digestion and ICP/MS
Single Addition NAG	AMIRA
NAG Extract with pH, EC, SO ₄ and ICP/MS scan (includes Hg)	AMIRA
Sequential NAG (per cycle)	AMIRA
MEND SFE / SPLP with pH, EC, SO ₄ and ICP/MS scan (includes Hg)	MEND
MWMP with pH, EC, SO ₄ and ICP/MS scan (includes Hg)	ASTM E2242
Rietveld XRD	Rietveld
Optical Microscopy on Polished Thin Sections	Optical Microscopy
QEMSCAN (based on one sample; discounts apply for multiple samples; chemical assays extra)	QEMSCAN/SEM

STATIC TESTING

- Geochemical analysis (sulphur speciation, carbon speciation, WRA, trace metals)
- Petrographic examination (Rietveld XRD, optical microscopy on polished thin sections, SEM, QEMSCAN)
- Sequential leach extractions and batch extractions
- Acid base accounting (ABA) by any method
- Pyrolysis methods for sulphur speciation
- Single Addition NAG, sequential NAG and NAG Extract
- Static water extractions (SPLP, MEND shakeflask extraction, MWMP, TCLP)

KINETIC TESTING

Kinetic tests are used to evaluate disposal and storage options and/ or to confirm acid generation potential and metal leaching using standard or custom test methods include:

- MEND humidity cell
- ASTM humidity cell
- Small and large custom leach columns (lysimeters)
- Custom aerobic or anoxic subaqueous disposal columns

Water analyses include:

- pH, oxidation/reduction, electrical conductance, total alkalinity, hydroxide alkalinity, carbonate alkalinity, bicarbonate alkalinity, acidity, DOC, TDS, TSS, hardness
- Anion analyses such as F, Cl, Br, SO₄, NO₃⁻, NO₂⁻, total P, ortho-P, TKN, ammonia-N
- Dissolved and total metals analyses by ICP/OES and ICP/MS, Hg by CV/AF

Radiochemistry



Mining and processing of metal ores can generate large quantities of Naturally Occurring Radioactive Materials waste (NORM) located in ore tailings and smelter slag or in concentrates. Rare Earth Elements (REEs) are often found in conjunction with uranium and thorium. The production of REE usually generates large volumes of thorium hydroxide and residues that contain Lead-210 and Radium. Titanium ores often have elevated thorium and uranium that are concentrated during the processing. Tantalum usually occurs with niobium and concentration by gravity methods retains

radioisotope contaminants in the concentrate. Zirconium processing retains contaminating radionuclides which are also frequently found with the concentrate.

Bureau Veritas provides analytical solutions to ensure compliance with Federal and Provincial regulations and Guidelines for the Management of NORM (Health Canada) including:

- Analysis for NORM in geological, metallurgical and environmental samples
- Waste characterization
- Comprehensive MDMER compliance including analysis of Radium-226

WATER TESTING

ANALYSIS	LEAD TIME (DAYS)	DETECTION LIMIT	CAD
Radium-226	10	0.01 Bq/L	\$125.00
Radium-228	10	various Bq/L	\$160.00
Lead-210	20	0.1 Bq/L	\$190.00
Polonium-210	10	0.01 Bq/L	\$150.00
Thorium Isotopes (Th-228, Th-230, and Th-232)	10	0.1 Bq/L	\$135.00
U-238, Th-232 by NAA	10	0.01 Bq/L	\$50.00
Gamma Spectroscopy (Th-234, Th-230, Pb-212, Ra-228, Ra-226, Pb-210, U-235)	10	Various Bq/L	\$160.00
Radon-222	10	10 Bq/L	\$90.00
Cesium-137 and Iodine-131	10	1 Bq/L	\$125.00
Strontium-90	10	0.1 Bq/L	\$300.00

Neutron Activation Analysis (NAA)

NAA is a highly sensitive, accurate technique used for quantitative analysis of major, minor, and trace elements. This multi-element method requires no or minimal sample preparation and is suitable for solids, liquids, gases, mixtures, and suspensions. Neutron activation analysis has applications in geological samples (coal, ore, rock, sediment, vegetation).

Advantages of trace elements by NAA include:

- Acknowledged “referee method” – generally free of matrix effects or contamination from laboratory chemicals
- No or minimal sample preparation making it amenable for analysis of complicated or difficult matrices
- Multi-element analysis – one method can analyze 30+ elements
- Analyzes total element content (vs. digestion procedures)

- Sensitivity to parts-per-billion for specific elements
- Milligram-small sample size (mg); where samples are precious or limited
- Customizable analysis to meet customer's precise needs

Applications of trace element by neutron activation analysis include:

- Geological surveys
- Platinum group elements
- Halogen analysis (F, Cl, Br, I)
- Coal testing
- Analysis of difficult or complicated matrices

INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS (INAA)

NAA should be the technique of choice for high-accuracy trace-element analysis, to validate or verify standards and the results of other methods, and for matrices and elements that are difficult to do by other methods

CODE	ELEM	DETECTION LIMIT	ELEM	DETECTION LIMIT	CAD
NA-LLE-S	Total determination of Au by gamma ray analysis after nuclear irradiation, 35 elements, 10–30 g				\$50.00
	Ag	5 ppm	Mo	1 ppm	
	As	0.5 ppm	Na	0.01 %	
	Au	2 ppb	Nd	5 ppm	
	Ba	50 ppm	Ni	100 ppm	
	Br	0.5 ppm	Rb	15 ppm	
	Ca	1 %	Sb	0.1 ppm	
	Ce	3 ppm	Sc	0.1 ppm	
	Co	1 ppm	Se	3 ppm	
	Cr	5 ppm	Sm	0.1 ppm	
	Cs	1 ppm	Sn	0.01 %	
	Eu	0.2 ppm	Sr	0.05 %	
	Fe	0.01 %	Ta	0.5 ppm	
	Hf	1 ppm	Tb	0.5 ppm	
	Hg	1 ppm	Th	0.2 ppm	
	Ir	5 ppb	U	0.5 ppm	
	La	0.5 ppm	W	1 ppm	
	Lu	0.05 ppm	Yb	0.2 ppm	
			Zn	50 ppm	

CODE	ELEM	CAD
NA-CL	Cl	Shipping charges may apply \$43.00

NEUTRON ACTIVATION-PLATINUM GROUP ELEMENTS-SOLID (NA-PGE-S)

Samples are subjected to a nickel-sulphide fire assay pre-concentration followed by irradiation and analysis on the sulphide precipitate. Metals that are collected as sulfides during the fusion (Ag, Au, Cu, Pb, Zn, Hg, As, Sb) may interfere with the analysis.

	ELEM	DETECTION LIMIT	UPPER LIMIT	CAD
Full Package	Au	1 ppb	1 ppm	\$178.50
	Pt	20 ppb	10 ppm	
	Pd	20 ppb	10 ppm	
Partial Package	Rh	5 ppb	1 ppm	\$157.50
	Ru	50 ppb	20 ppm	
	Ir	1 ppb	1 ppm	
	Os	10 ppb	1 ppm	

Industrial Hygiene



Bureau Veritas has been providing analytical support to the industrial hygiene sector, including mining clients, for more than 55 years. Our laboratories are accredited by the American Industrial Hygiene Association Laboratory Accreditation Program (AIHA-LAP, LLC) for a wide range of tests in the industrial hygiene and environmental lead programs. Bureau Veritas offers analysis for the majority of methods published by OSHA and NIOSH. We also perform methods promulgated by the Environmental Protection Agency (EPA), ASTM, ISO, and published journal methods.

Our most popular tests for the mining industry include:

- Particulate (total and respirable)
- Respirable crystalline silica
- Diesel particulate (elemental and organic carbon)
- Mercury
- Metals
- Acids, especially sulphuric acid
- Other sulphur compounds (hydrogen sulphide, sulphur dioxide, carbon disulphide)

AIR TESTING

ANALYSIS	METHOD	CAD
Ammonia	NIOSH 6016	\$80.00
Diesel particulate matter (DPM)	NIOSH 5040	\$80.00
Jewel Impactor for DPM (if required)	NIOSH 5040	\$62.00
Hydrogen Cyanide	NIOSH 6010	\$116.00
Isocyanates scan (2,4-TDI, 2,6-TDI, MDI, HDI, IPDI)	OSHA 42/47 /PV2034	\$267.00
Mercury (vapour)	NIOSH 6009	\$75.00
Mercury (particulate)	OSHA ID-145	\$75.00
Oils/Lubricants/Metal-working fluids and particulate	NIOSH 5524/ NIOSH 0500	\$93.00
Quartz, crystalline silica	NIOSH 7500	\$89.00
Respirable Dust	NIOSH 0600	\$27.00
Single metal (Lead, Manganese)	NIOSH 7303 or OSHA ID-125G	\$44.00
Styrene (Sorbent tube)	NIOSH 1501 or OSHA 89	\$66.00
Welding fume scan (13 metals)	OSHA ID-125G	\$199.00
Welding - Hexavalent chromium	OSHA ID-125	\$96.00



Contact us for quote

Our laboratory can offer additional price options for collecting vapours on badges or combining multiple analyses on a single sample. Contact us for a personalized price quotation.

MICROSCOPY

Our microscopy team has more than 30 years of experience supporting site investigations, remedial investigations, and other mining industry testing needs. Our microscopy team takes pride in providing unique solutions to challenging problems through materials characterization and minerals identification.

We can determine sample composition, fiber and particle size, foreign substances or physical defects, material origination, and various other properties.

Our laboratory offers a range of applications for the mining industry:

- Worker exposure testing
- Minerals identification
- Regulated asbestos in air, bulk and dust samples
- Non-regulated amphiboles
- Talc, erionite, and other minerals

AIR TESTING

ANALYSIS	MATRIX	METHOD	CAD
Asbestos Fibers	Air	NIOSH 7402	\$192.00
Asbestos and Other Fibers	Air	NIOSH 7400A	\$23.00

INORGANIC MATERIALS CHARACTERIZATION

ANALYSIS	MATRIX	METHOD	CAD
PLM Materials Characterization	Bulk	EPA-600/R-93/116	by quote
TEM Materials Characterization	Air & Bulk	EPA-600/R-93/116	by quote
SEM Materials Characterization	Air & Bulk	SEM MC	by quote

MINERALS CHARACTERIZATION

ANALYSIS	MATRIX	METHOD	CAD
Erionite	Air & Bulk	TEM Semi-quantitative	by quote
Talc	Air & Bulk	Contact us for details	by quote
Other minerals	Air & Bulk	Contact us for details	by quote



SAMPLE COLLECTION KITS

Bureau Veritas provides all the materials required for your analytical testing program to ensure samples are collected in clean and sterile (required for microbiology) containers. When measuring metals at low concentrations, instrument sensitivity is often not the limiting factor to achieving reliable detection limits. Equally important is the control of contamination from sampling equipment and various environmental factors. Bureau Veritas has developed sampling kits specifically designed for our mining customers, who are collecting samples in pristine environments.

When ultra-low detection limits are required, these clean sampling kits reduce the risk of contamination in the field and support the collection of reliable, accurate data.

Ambient Air Quality



Particulates and metals

AMBIENT AIR MONITORING

Bureau Veritas offers the sampling media and analyses for particulates as TSP or PM10 collected on pre-weighed quartz hi-vol filters (8" x 10") or PM2.5 on 47 mm Teflon filters. A series of metals can be tested subsequently from the same filter either by ICP/Axial or ICP/MS. The reference methods are US EPA IO-2 and IO-3. We also offer dustfall measurement using methods based on ASTM 1739 (as deposited particulate and metals content).

AIR TESTING

ANALYSIS	METHOD	CAD
Metals scan by ICP/Axial or ICP/MS	US EPA IO-3	\$95.00
PM2.5 on 47 mm Teflon filter (includes filter)	US EPA IO-2	\$50.00
TSP or PM10 on hi-vol quartz filter (includes filter)	US EPA IO-2	\$55.00



Organics

AMBIENT AIR MEASUREMENT

From preparation of field sampling media to the collection of air and the subsequent analysis, Bureau Veritas has extensive experience in all phases of testing of ambient air sources. For over 25 years, we have been active in the measurement of a large number of compounds in ambient air including Dioxins and Furans (EPA TO9), PCBs (TO4), semi-volatiles (TO13) and emerging Persistent Organic Pollutants (POPs). We offer methods TO14, TO15 and TO17 for volatile organics using Tedlar bags, thermal desorption tubes and low-level VOCs using SUMMA® canisters.

AIR TESTING

ANALYSIS	METHOD	CAD
Dioxins and Furans on PUF (included)	US EPA TO9	\$950.00
PAHs - selected list on PUF (included)	US EPA TO13	\$350.00
PCBs as congeners on PUF (included)	US EPA TO4	\$675.00
VOCs by SUMMA canister (rental included; selected list of VOCs)	US EPA TO14 or TO15	\$465.00
VOCs by TD Tube (selected list)	US EPA TO17	\$375.00

Environmental DNA (eDNA)



Environmental DNA (eDNA) testing is an exciting new tool available to augment, or replace conventional ecological survey methods for the detection of species of management interest. eDNA refers to the genetic material (nuclear, mitochondrial or chloroplast DNA) that is released by an organism (as shed gametes, skin/plant cells, body fluids, etc.) to its environment and can be collected from that environment using water, sediment, or soil sampling. Bureau Veritas tests eDNA samples for presence of target species using quantitative

PCR (qPCR) assays that have been thoroughly validated for both specificity and sensitivity using field-derived samples. eDNA testing is completed to ISO 17025 standards at Bureau Veritas' DNA centre of excellence located in Guelph, Ontario. Bureau Veritas is the largest private DNA testing laboratory in Canada. Bureau Veritas was the first private Canadian forensic biology and DNA testing laboratory to be accredited by the Standards Council of Canada (in 2000).

eDNA TESTING

ANALYSIS	METHOD	CAD
eDNA isolation and quality check*	qPCR	\$60.00
eDNA assay for target species/genera	qPCR	\$65.00
eDNA Sampling Kit	<ul style="list-style-type: none"> - 1 L HDPE/HDPP sampling bottle - 250 mL filter funnel with 0.45 micron cellulose nitrate membrane filter included - Paper envelope for filter storage (3"x5" or similar) included - Plastic, zipper-seal bag included - Silica bead desiccant included 	\$38.00
eDNA Water Sample Filtration**	Includes supply of 1 L HDPE/HDPP sampling bottle to the customer and filtration and sample preservation service at Bureau Veritas	\$65.00

* Typically, a single eDNA isolation yields sufficient DNA for up to 5 eDNA assays.

** eDNA sampling kit provides consumables required for eDNA water sampling and filtration in the field. A surcharge of \$25 per order is applied to eDNA Sampling Kit orders of less than 10 units. Ground courier shipment is included in the unit rate. Customers will be billed additional for any air courier service request. To ensure the best quality of collected eDNA water samples must be filtered and preserved within 24-hours of sample collection. Filtration equipment is required.

AVAILABLE eDNA ASSAYS

eDNA TEST	SPECIES	COMMON NAME	
Frog	RAAU	Rana aurora	Northern red-legged frog
	ASMO	Ascaphus montanus	Rocky mountain tailed frog
	LICA	Lithobates (Rana) catesbeiana	North American bullfrog
	ANBO	Anaxyrus (Bufo) boreas	Western toad
	RAPR	Rana pretiosa	Oregon spotted frog
	ASTR	Ascaphus truei	Pacific (Coastal) tailed frog
Fish	ONTS	Oncorhynchus tshawytscha	Chinook salmon
	ONKI	Oncorhynchus kisutch	Coho salmon
	THAR	Thymallus arcticus	Arctic grayling
	ONCL	Oncorhynchus clarkii	Cutthroat trout
	ONMY	Oncorhynchus mykiss	Rainbow trout (Steelhead trout)
	ONNE	Oncorhynchus nerka	Sockeye salmon
	ESLU	Esox lucius	Northern pike
	MISA	Micropterus salmoides	Largemouth bass
	ONGO	Oncorhynchus gorbuscha	Pink salmon
	ONKE	Oncorhynchus keta	Chum salmon
Fish - Efish	THAR	Thymallus arcticus	Arctic grayling
	ONCL	Oncorhynchus clarkii	Cutthroat trout
	ONMY	Oncorhynchus mykiss	Rainbow trout
	ONTS	Oncorhynchus tshawytscha	Chinook salmon
	ONKI	Oncorhynchus kisutch	Coho salmon
	SASA	Salmo salar	Atlantic salmon
Other	SAMA	Salvelinus malma	Dolly Varden
	PRCY	Prosopium cylindraceum	Round whitefish
	COCO	Cottus cognatus	Slimy sculpin
	AMMV (AMTI)	Ambystoma mavortium	Blotched tiger salamander
		Ambystoma tigrinum	Tiger salamander
	SOBE	Sorex bendirii	Pacific water shrew

Metals and Diamond Mining Effluent Regulations (MDMER)



The updates to Canada's Metal and Diamond Mining Effluent Regulations (MDMER) were aimed at strengthening the effluent quality standards, and improving the efficiency of environmental effects monitoring (EEM). The outcomes from these amendments included reduced risks of negative effects on fish and fish habitat, improvement of the efficiency of certain performance measurement and evaluation requirements, and more transparency in the regulatory process. Bureau Veritas Laboratories has designed analytical packages to help our mining sector customers meet the MDMER requirements:

EFFLUENT MONITORING

- Prescribed Deleterious Substances
- Acute Lethality Testing

ENVIRONMENTAL EFFECT MONITORING STUDIES (EEMS)

- Effluent Characterization
- Water Quality Monitoring
- Sublethal Toxicity Testing
- Biological Monitoring Studies

EFFLUENT LIMIT COMPARISONS (mg/L)

PRESCRIBED DELETERIOUS SUBSTANCES	MMER (Max Monthly Mean)	MDMER (1-Jun-2021)		LABORATORY DETECTION LIMIT (mg/L)			
		Existing Metal and Diamond Mines	New Metal and Diamond Mines	Required Detection Limit (mg/L)	Routine	Low Level	Trace Level*
Arsenic	0.50	0.30	0.10	0.0025	0.001	0.00002	0.000005
Copper	0.30	no change	0.10	0.001	0.001	0.00005	0.00002
Cyanide	1.00	0.50	0.50	0.005		0.005	
Lead	0.20	0.10	0.08	0.0005	0.0005	0.000005	0.000003
Nickel	0.50	no change	0.25	0.0125	0.001	0.00002	0.000015
Zinc	0.50	no change	0.40	0.010	0.005	0.0001	0.00006
Radium-226	0.37 Bq/L	no change	no change	0.01 Bq/L		0.01 Bq/L	
TSS	15.00	no change	no change	2.000		1.00	
Un-ionized Ammonia (as Nitrogen)	no limit	0.50	0.50	0.05		0.02	

ENVIRONMENTAL EFFECT STUDIES EFFLUENT CHARACTERIZATION - NEW SUBSTANCES

PARAMETER	MMER	MDMER (1-Jun-2018)		DETECTION LIMIT (mg/L)		
		MDMER	Required Detection Limit (mg/L)	Routine	Low Level	Trace Level*
Aluminium	X	X	0.005	0.005	0.0005	0.0001
Cadmium	X	X	0.000045	0.0001	0.000005	0.000003
Iron	X	X	0.15	0.1	0.001	0.0001
Mercury	X	X	0.00001	0.00000001	0.00000001	1.9E-09
Molybdenum	X	X	0.0365	0.0005	0.00005	0.000005
Selenium	X	X	0.0005	0.002	0.00004	0.00001
Nitrate (as Nitrogen)	X	X	1.46835		0.1	
Ammonia (as Nitrogen)	X	X	0.05		0.02	
Chloride		X	60		1	
Chromium		X	0.00445	0.005	0.0001	0.00002
Cobalt		X	0.00125	0.0005	0.000005	0.000004
Manganese		X	0.005	0.002	0.00005	0.000004
Phosphorous (as P)		X	0.05	0.1	0.002	-
Sulfate		X	0.6		0.5	
Thallium		X	0.0004	0.00005	0.000002	0.0000008
Uranium		X	0.0075	0.0001	0.000002	0.0000005

* The ICP-QQQ (triple quadrupole mass spectrometer) is a new service offering. This method is for pristine water samples only. Additional costs apply.

Customer Portal

Bureau Veritas' market leading web-based digital services demonstrate our commitment to continuous improvement of the customer experience. Each step along the way from submission through to invoicing is complimented with a digital service. Bureau Veritas' latest addition to our suite of digital services is an electronic submission process that promises to modernize the current paper-based workflow. The combined impacts to all stakeholders include efficiency and quality improvements with no cost of entry.



ELECTRONIC CHAIN OF CUSTODY (eCOC)

FIELD STAFF

Reduce errors and uncertainty with real time access to sampling requirements

PROJECT MANAGERS

Ensure analytical program consistency in just a few clicks; set up your program once and cascade the requirements to the rest of the your team

REPORT GENERATORS

Reduce the need to cleanse/correct data entry errors and omissions prior to reporting

LEADERS

Modernize your workflow to unlock productivity and quality gains to create a competitive advantage for your organization

COMPLIANCE OFFICERS

Ensure adherence to analytical program requirements with time saving and flexible templates



DATA ACCESS

Bureau Veritas' Customer Portal is an extension of our LIMS (Laboratory Information Management System) giving you real-time access to up to the minute information. This approach to system architecture also means that all historical data, job files, invoices, and reports are available as soon as you sign up and login.



CUSTOM REPORT WIZARD

Bureau Veritas' Custom Reports tool allows you to quickly isolate and merge data without the risk associated with manually cutting and pasting data from multiple Excel files. From retrieving the results for a particular sampling point and specified time frame to summarizing all project results into a single table, the Custom Reports Wizard has the power and flexibility to connect you with the data set you need.



INVOICE MODULE

Make AP management easy with Bureau Veritas' invoice module that provides a full view into your analytical spend. Search and retrieve invoices, track project spend or leverage the tool as part of your payment approval workflow. To find out more about how Bureau Veritas' Customer Portal can help, please contact your account manager or the Digital Solutions Group at: DSG@bvlabs.com

CLIENT REAL-TIME ACCESS

Please refer to Bureau Veritas Laboratories' standard Terms and Conditions at www.bvlabs.com.



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Oxides Conversion Factors

ELEMENT	CONVERSION FACTOR	OXIDE
Al	1.889	Al ₂ O ₃
Ba	1.669	BaSO ₄
	1.116	BaO
Be	2.775	BeO
C	3.666	CO ₂
Ca	1.399	CaO
	2.497	CaCO ₃
Cr	1.461	Cr ₂ O ₃
F	2.055	CaF ₂
Fe	1.286	FeO
	1.430	Fe ₂ O ₃
K	1.205	K ₂ O
Mg	1.658	MgO
	3.468	MgCO ₃
Mn	1.291	MnO
Na	1.348	Na ₂ O
Nb	1.431	Nb ₂ O ₅
Ni	1.273	NiO
P	2.291	P ₂ O ₅
Pb	1.077	PbO
Rb	1.094	Rb ₂ O
S	2.497	SO ₃
	2.996	SO ₄
Si	2.139	SiO ₂
Sn	1.270	SnO ₂
Sr	1.185	SrO
Ta	1.221	Ta ₂ O ₅
Th	1.138	ThO ₂
Ti	1.668	TiO ₂
U	1.179	U ₃ O ₈
V	1.785	V ₂ O ₅
W	1.261	WO ₃
Y	1.270	Y ₂ O ₃
Zn	1.244	ZnO
Zr	1.351	ZrO ₂

Mesh to Micron Conversion Chart

OPENING	US STANDARD	TYLER
2.00mm	10	9
1.70mm	12	10
1.40mm	14	12
1.18mm	16	14
1.00mm	18	16
850µm	20	20
710µm	25	24
600µm	30	28
500µm	35	32
425µm	40	35
355µm	45	42
300µm	50	48
250µm	60	60
212µm	70	65
180µm	80	80
150µm	100	100
125µm	120	115
106µm	140	150
90µm	170	170
75µm	200	200
63µm	230	250
53µm	270	270
45µm	325	325
38µm	400	400

Assay valuations

VALUE	PARTS PER MILLION (ppm)	METRIC TONNE	SHORT TON	LONG TON
1 Gram / MT	1	0.03215	0.02917	0.03266
1 Troy oz / MT	31.104	1	0.9072	1.106
1 Troy oz / ST	34.286	1.1023	1	1.120
1 Troy oz / LT	30.612	0.9842	0.8929	1

CONVERSION FOR WEIGHTS	TROY OZ.	AVOIRDUPOIS OZ.	GRAMS
1 Troy oz.	1	1.0971	31.104
1 Avoirdupois oz.	0.91146	1	28.35
1 Gram	0.03215	0.03527	1

1 Metric Tonne (MT) = 1000 kilograms = 2204.6 pounds

1 Short Ton (ST) = 907.2 kilograms = 2000 pounds

1 Long Ton (LT) = 1016 kilograms = 2240 pounds



BUREAU
VERITAS

SHAPING A WORLD OF TRUST