

Schedule of Services & Charges 2016 Africa USD



Providing services across the resources supply chain

Intertek is a leading Total Quality Assurance provider to industries worldwide. Our network of more than 1,000 laboratories and offices and over 40,000 people in more than 100 countries, delivers innovative and bespoke Assurance, Testing, Inspection and Certification solutions for our customers' operations and supply chains. Intertek supports companies' success in the global marketplace, by helping customers to meet end users' expectations for safety, sustainability, performance, integrity and desirability in virtually any market worldwide.

Our network of mineral laboratories offer world class geochemical assay and testing services including sample preparation, fire assay and precious metal analysis, exploration geochemistry, environmental testing, mine-site laboratories, coal testing and inspection, consulting minerals inspection, robotics and automated laboratory systems.



Minerals inspection services are available at all major ports & distribution centres. Visit our website on up to date information on locations, services and fact sheets www.intertek.com/minerals/



Quality analysis,
efficient, independent,
& cost-effective
service.
Global scope,
local presence.

100
Countries

1000
Laboratories

40,000
Employees

Robotics and Automated Minerals Laboratory Systems

Intertek is the largest global commercial operator of automated and robotic mine site laboratories.

Intertek automated and robotic sample systems are purpose built, ranging from individual cells to fully integrated systems, providing complete end-to-end sampling to analysis solutions.

Using advanced robotic sample handling technology for minerals testing has distinct advantages, including rapid sample throughput, unparalleled consistency, exclusion of human error, a comprehensive audit trail, synchronised process control, reliability and fully programmable comminution parameters. Programmable parameters ensure that ores obtain the requisite treatment consistently.

Robotic systems reduce OH&S exposure to employees, eliminating heavy lifting and isolating personnel from hazardous materials. Thus significantly improving safety.

Labtrak

Labtrak is a one-stop application that facilitates the rapid, secure tracking of analytical jobs, viewing of quality control charts as well as downloading of both preliminary and final results in user defined formats. Labtrak is updated continually, reflecting ongoing changes to the job status and can be accessed using any common web browser.

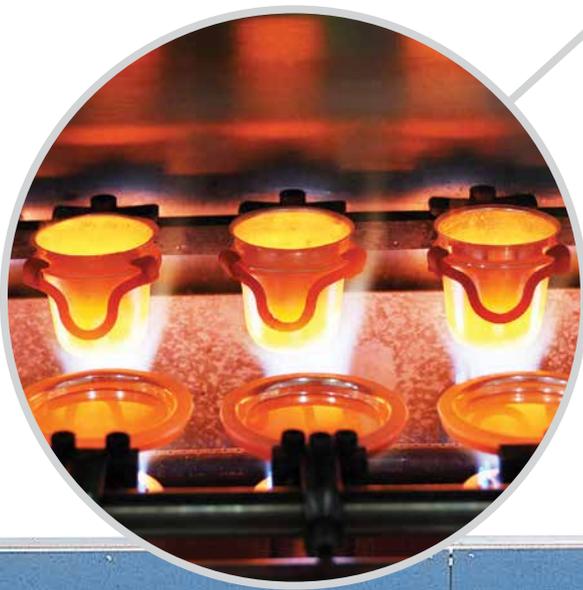
Advances in Geochemical Analysis

The challenge of identifying geochemical anomalies related to concealed mineral deposits has driven innovation and development in analytical geochemistry.

Streamlined, ultra-clean digestions coupled with the latest ICP-MS collision cell technology offer improved detection limits commensurate with the crustal abundance of almost all elements, with an emphasis on long-term reproducibility.



Innovation through technology



Mine-Site Laboratories

Intertek designs, commissions and operates dedicated mine-site laboratories in remote locations and key mining regions across the globe and supports a range of mineral commodities. Mine-site laboratory services range from sample preparation installations to full service analytical laboratories and automated robotic facilities.

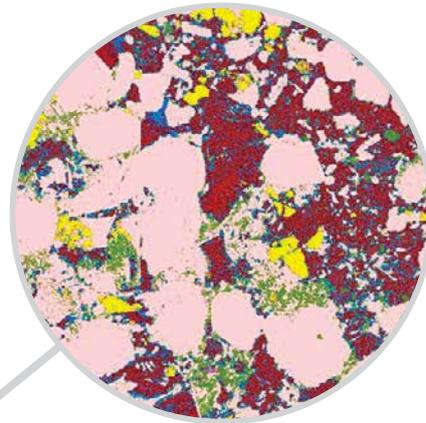
Intertek's minerals laboratories are operated by experienced personnel with support from an extensive global laboratory network. Fast, accurate and independent mineral analyses by Intertek allow mining companies to effectively manage their process control and regulatory reporting requirements.

Outsourcing your mine-site laboratory to Intertek ensures your operation will benefit from world-class expertise and services, which enables your company to focus resources and capital on the core business.

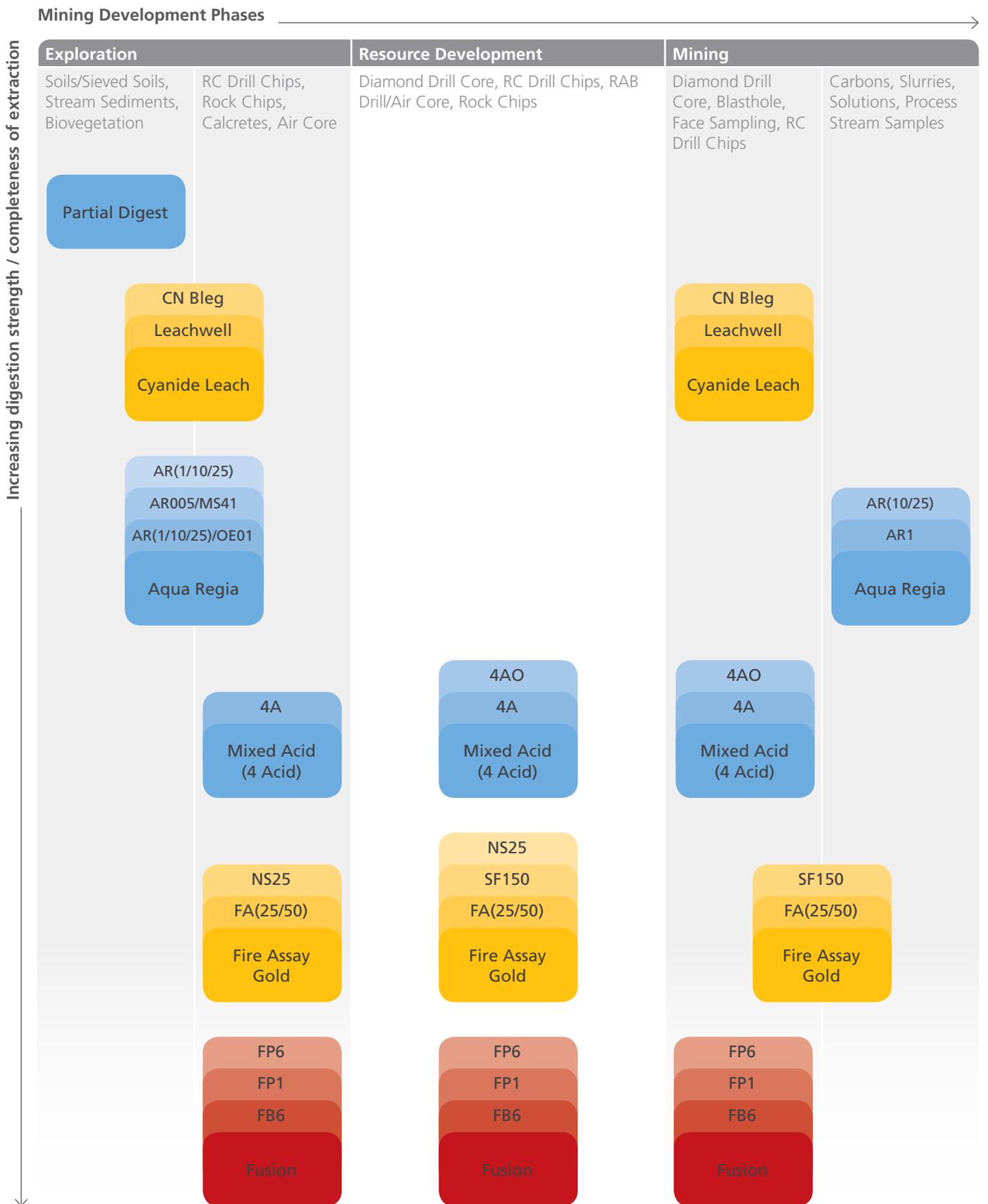
Mineralogy

Intertek's leading expertise and state-of-the-art facilities offer a range of mineralogical services. Industry experts in XRF and XRD support local and global operations, producing quality reliable data with the reassurance of years of experience and a proven track record.

- Research quality lithochemical packages
- Applied Mineralogy - XRD Specialist on-site
- Low cost XRF & spectral scanning
- TerraSpec Near-Infrared Spectroscopy



Applications



The Australian schedule outlines the most commonly used analytical procedures. Not all methods are available at all locations. Please contact your local manager to discuss your specific requirements or for any services not listed.

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Sample Preparation

The production of a homogeneous sub-sample, representative of the material submitted to the laboratory is the primary purpose of sample preparation. Correct preparation is critical to obtaining meaningful analytical results. The selection of the actual sample preparation procedures will depend on the type and size of the sample, the mineralogy as well as the client's analytical and budgetary requirements.

Segregation into high and low grade sample preparation areas and utilisation of techniques such as vacuuming pulveriser vessels and/or quartz washes between samples reduces the potential for contamination. Robotic preparation employing quartz washes is also available at some facilities.

Close and ongoing consultation with your Laboratory Manager or Sales Representative will ensure that optimal sample preparation techniques are employed thus maximising the value added in the analytical process.

Sample Submission

Correct submission and receipt of samples is critical in retaining the integrity of the sample chain of custody and facilitating efficient processing of samples. Detailed instructions can be found on Page 41 and submission forms can be downloaded from the Intertek website www.intertek.com/minerals

Sample submission and freight information emailed prior to despatch will expedite the sample receipt process. Upon receipt, samples are issued with a unique barcode ID through the LIMS. Clients are encouraged to submit pre barcoded samples to enable efficient sample receipt and reconciliation.

Description	Code	Price
Quarantine treatment – pulps or samples in standard paper packets	QS01	\$1.00
Quarantine treatment - bulk samples up to 3kg	QS02	\$2.65
Sample pick up and transport	TP01	POA
Environmental waste disposal levy	WL	\$0.50

Hazardous Samples

Handling of samples containing hazardous material requires special procedures and incurs additional charges. Please ensure that the sample submission is clearly marked, describing the category of hazard and clearly identify the samples that contain the hazard. A dangerous goods form is available to download from our website which should accompany such samples. We appreciate that at times it may be difficult to identify a hazard but please err on the side of caution.

Description	Code	Price
Fibrous Material (Asbestos) received as pulps	AP01	Batch fee \$37 + \$0.50/sample
Fibrous Material (Asbestos) requiring preparation	AP02	Batch fee \$112 + \$2.25/sample
Naturally Occurring Radioactive Material (NORM) received as pulps	RM01	\$0.50/sample
Naturally Occurring Radioactive Material (NORM) requiring preparation	RM02	\$0.75/sample
Naturally Occurring Radioactive Material (NORM) miscellaneous handling	RM03	POA

By regulation all radioactive material must be returned to the client. This will be at the client's expense.

Sample Storage

All solid samples (assay pulps, bulk pulps and residues) will be stored without charge for 60 days after completion of the analysis. After this time all samples will be stored at a daily rate until the client's written advice regarding return, collection or disposal is received. If storage information is not supplied on the submission, or arranged with the laboratory in writing, the default will be to store the samples with applicable charges.

Samples submitted as all liquids will be stored (at the ambient temperature), without charge, for 60 days after completion of analysis and then discarded, unless the laboratory is advised otherwise in writing.

Description	Code	Price
Storage of bulk or pulp samples calculated daily after 60 days	ST10	\$3.00/m ³
Bulk disposal of samples	ST20	\$112.00/m ³
Bulk disposal of hazardous materials		POA
Expenses related to the return of samples	ST30	At cost
Retrieval of selected samples from storage	ST40	\$63.00/hr

Freight

Freight expenses incurred will be passed on at cost. For further information please contact the laboratory.

Sample Preparation Packages

To facilitate easy selection of sample preparation procedures, commonly used techniques have been packaged together.

Soil, RAB and RC

Description	Code	Price
Dry, pulverise up to 300g	SP01	\$3.15
Dry, pulverise 300g up to 1.2kg	SP02	\$4.75
Dry, pulverise 1.2kg up to 3kg	SP03	\$5.50
Additional wt >3kg: dry, split, pulverise up to 3kg, discard reject	SP05	\$0.75/kg*

Quartz wash packages are available on request

Drill Core and Rock

Description	Code	Price
Dry, crush ~10mm, pulverise up to 300g	SP11	\$3.50
Dry, crush ~10mm, pulverise 300g up to 1.2kg	SP12	\$5.00
Dry, crush ~10mm, pulverise 1.2kg up to 3kg	SP13	\$6.70
Additional wt >3kg: dry, crush ~2mm, split, pulverise up to 3kg, retain coarse reject	SP15	\$1.10/kg*

Quartz wash packages are available on request

Robotic Preparation (including single quartz wash)

Description	Code	Price
Dry, robotic preparation 300g up to 1.2kg	SP21	\$4.75
Dry, crush ~2mm, robotic preparation 300g up to 1.2kg	SP22	\$5.50
Dry, crush up to 3kg ~2mm, split, robotic preparation 1.2kg	SP23	\$7.00
Additional wt >3kg: dry, crush ~2mm, split, robotic preparation	SP24	\$1.10/kg*

Robotic Iron Ore Package (excluding quartz wash)

Description	Code	Price
Dry, robotic preparation 300g up to 1.2kg	SP31	\$4.30
Dry, crush ~2mm, robotic preparation 300g up to 1.2kg	SP32	\$5.00
Dry, crush up to 3kg ~2mm, split, robotic preparation 1.2kg	SP33	\$6.70
Additional wt >3kg: dry, crush ~2mm, split, robotic preparation	SP34	\$1.10/kg*

Sample Preparation Procedures

Drying

Sample drying procedures will vary due to the sample type and mass, moisture content and analysis required.

Description	Code	Price
Sort samples received in standard paper packets	SD01	\$0.50
Sort and dry samples	SD02	\$0.50/kg
Low temperature drying	SD03	\$0.75/kg

Crushing

Samples with a volume or dimensions exceeding that which the pulverising vessels can accommodate may require crushing and/or splitting prior to pulverising. Crushing may also be required to achieve an optimum particle size to split to a representative sub sample for further particle size reduction.

Description	Code	Price
Crush to ~10mm - Jaw Crusher	CR01	\$0.50/kg
Crush to ~2mm - Boyd Crusher	CR02	\$1.00/kg

Splitting

Splitting of samples may be done to achieve a more cost effective option in reducing the volume of sample for further particle size reduction steps.

Two types of splitters are used; the riffle splitter sometimes called a Jones Spitter and the Rotary Splitter. It is important to select the correct size splitter for the product. The correct splitting technique is also important to avoid introducing a bias.

Description	Code	Price
Riffle splitting – Up to 6kg discard reject	RF01	\$2.00
Riffle splitting – Up to 6kg retain reject	RF02	\$2.50
Additional riffle splitting options		POA
Rotary or linear splitting	RS01	\$0.50/kg

Pulverising

Pulverising is carried out on crushed or fine products to produce a fine homogeneous powder to enable small sub-samples to be taken for analysis that will be representative of the larger coarse sample. For most sample types at least 85% of material will be pulverised to 75µm or better.

All devices used in the crushing and pulverising of samples can impart trace levels of contaminants. Low chrome steel is usually the preferred material of choice for pulverising vessels as the chrome and iron contamination is usually negligible compared with the levels commonly encountered in most geological materials. Other options such as tungsten carbide (WC) and zirconia (Zr) vessels are available if required.

Description	Code	Price
Up to 300g	PU01	\$3.00
300g to 1.2kg	PU02	\$4.00
1.2 to 3kg	PU03	\$5.00
1.2kg up to 3kg, additional fine pulverise assay split	PU04	\$6.00
Additional weight per 3kg or part thereof	PU05	\$6.00
WC bowl 100g	WC01	\$6.00
Zr bowl 100g	ZR01	\$8.00
Quartz wash (discarded)	QW01	\$2.50
Quartz wash (retained)	QW02	\$3.50
Crusher clean (barren material)	CRW01	\$1.50

Sieving

Sieving may be performed on unprocessed samples to determine the mass distribution of the various size fractions or alternatively, on crushed or pulverised products to ascertain the effectiveness of the processes.

Description	Code	Price
Dry sieve specified mesh size 1 fraction (not less than 180µm)	SV12	\$12.00/kg
Additional dry sieve to specified mesh sizes (not less than 180µm)	SV12A	\$3.00/screen
Wet sieve (retain oversize only)	SV13	\$18.00/kg
Wet sieve (retain undersize only)	SV14	\$18.00/kg
Wet sieve (recovering undersize and oversize)	SV15	\$26.00/kg
Reporting of weights per fraction	WT01	\$1.00

QA Crush and Pulverise Checks

Measuring the quality of the comminution products during sample preparation is an integral part of the quality system. Grind quality can be determined using either wet screening or laser sizing, whereas the crusher quality is measured using dry screening. Monitoring the process maintains the sample preparation consistency and integrity which, in turn, minimises the variance of the sampling error when splits are taken from the products.

Description	Code	Price
Wet sieve to confirm sample preparation grind quality - passing 75µm	SV03	\$5.25
Laser particle size analyser to confirm sample prep grind quality p75µm*	SV17	\$2.50
QA Crush passing nominal 10mm - Jaw Crusher	QACR01	\$3.00
QA Crush passing nominal 2mm - Boyd Crusher	QACR02	\$3.50

* Note that slightly different data may be obtained when the laser sizer is compared with the gravimetric screen tests, as these methods measure different parameters.

Core Cutting

A number of Intertek sites possess core cutting facilities to perform the splitting, sample preparation, analysis and archiving of valuable geological samples. Drill core is often cut in varying ratios to provide a representative sample for analysis and reference.

Secure storage and rental space for core logging is available. Please contact us for more information.

Description	Code	Price
Core cutting (includes consumables and equipment)	CC01	\$82.00/hr
Other core cutting services		POA

Miscellaneous Procedures

Description	Code	Price
Compositing	CM01	\$63.00/hr
Mat mixing of pulps	MM01	\$1.50
Reporting weights of samples	WT01	\$1.00

Gravimetric Determinations

Element	Description	Detection Limit	Code	Price
LOD	Loss on drying (105°C or client nominated temperature)	0.01%	LOD/GR	\$7.50
LOI	Loss on ignition (1000°C or client nominated temperatures)	0.01%	LOI/GR	\$7.50
	Multiple temperatures each additional			\$2.00
SG	Specific gravity / core and rocks uncoated		SG/GR	\$11.25
SG	Specific gravity / core and rocks wax coated		SGW/GR	\$26.00
SG	Specific gravity / core and rocks lacquer coated		SGC/GR	\$26.00
SG	Specific gravity / metallurgy core and rocks wax coated		SGWM/GR	\$26.00
SG	Pulp density (gas pycnometer method)		SGP/PYC	\$6.50
SG	Liquid specific gravity		SGL/GR	\$15.00

TerraSpec NIR Scan

The TerraSpec 4 Hi Res spectrometer offers a rapid scan for the identification and characterisation of minerals visible in the NIR range. See page 38 for more details.

Description	Code	Price
TerraSpec 4 Hi Res scan	/NIR	POA
TSG Post processing mineralogy report - standard report (includes scan)	/NIR01	POA

Precious Metals Analysis

A diverse range of precious metal analytical techniques are available for a wide range of applications ranging from grassroots exploration, where sub ppb sensitivities are required, to accurate resource estimation and grade control.

Lead collection fire assay remains the classic method for gold, platinum and palladium, however, aqua regia digestion, accelerated cyanide leach and BLEG (bulk leach extractable gold) are available for specific purposes. The full suite of platinum group elements can be quantified using nickel sulphide collection fire assay.

Lead Collection Fire Assay

Fire assay flux recipes have been carefully formulated to optimise precious metal recovery in diverse mineralogical matrices. Further flux modification and reduction in charge weight can be used to improve recoveries in difficult sample matrices.

Element	Description	Detection Limit	Code	Price
Au	25g fire assay / ICP-OES	0.005ppm	FA25/OE04	\$9.00
	50g fire assay / ICP-OES		FA50/OE04	\$10.00
Au	25g fire assay / ICP-MS	1ppb	FA25/MS02	\$11.50
	50g fire assay / ICP-MS		FA50/MS02	\$12.50
Au	50g fire assay / AAS	0.005ppm	FA50/AA	\$10.00
	50g fire assay / AAS	0.01ppm	FA50/AA01	\$9.75
Au, Pt, Pd	25g fire assay / ICP-MS	1ppb, 0.5ppb, 0.5ppb	FA25/MS	\$15.50
	50g fire assay / ICP-MS		FA50/MS	\$16.50
Rh	25g fire assay / ICP-OES	5ppb	FA25P/OE	\$15.50

Concentrates, metallurgical and high grade samples

POA

Screen Fire Assay

Screen fire assays utilise a large sample mass, typically 1kg, and find application where the precious metal compositional and distributional heterogeneity in a pulp is such that a conventional fire assay would be accompanied by an unacceptable sampling error. The pulp sample is screened and the entire coarse fraction is fired assayed to recover the gold and/or PGEs. Duplicate assays are carried out on the more reproducible undersize fraction. The precious metal content is reported as a mass weighted mean along with the individual fractions' results.

Element	Description	Detection Limit	Code	Price
Au	1kg Screen fire assay 150µm / ICP-OES	0.01ppm	SF150/OE	\$56.00
	1kg Screen fire assay 100µm / ICP-OES		SF100/OE	\$67.00
	1kg Screen fire assay 75µm / ICP-OES		SF75/OE	\$82.00
	Additional oversize firing			\$12.00
Pt, Pd	Available on request			POA

Nickel Sulphide Collection Fire Assay

The specialised nickel sulphide collection fire assay method has been designed to quantitatively recover all of the platinum group elements. The precious metals are collected in a nickel sulphide matte which is dissolved leaving the Au and PGEs as a residue. This residue is filtered off, dissolved in aqua regia and read on an ICP-MS for low ppb detection limits.

Element	Description	Detection Limit	Code	Price
Au	NiS fire assay / ICP-MS	2ppb	NS25/MS	\$70.00
Pt, Pd, Rh, Ru, Ir, Os		1ppb		

Aqua Regia Digestion

Aqua regia is a low level, cost effective option for analysing gold and other elements in oxide, sulphide and carbonate minerals. It is an empirical method with tightly controlled digest conditions to optimise long term reproducibility. Refractory minerals and silicates may remain largely undigested. Pre roasting is required when samples contain appreciable non-carbonate carbon. Aqua regia digestion is a useful exploration tool and gold analysis can be coupled with multi element packages found under the Exploration Geochemistry section.

Element	Description	Detection Limit	Code	Price
Au	10g aqua regia / enhanced MS	0.1ppb	AR10/eMS	\$10.00
	25g aqua regia / enhanced MS		AR25/eMS	\$12.50
Au	10g aqua regia / MS	1ppb	AR10/aMS	\$7.50
	25g aqua regia / MS		AR25/aMS	\$9.75
Au	10g aqua regia / MS	0.01ppm	AR10/hMS	\$5.25
	25g aqua regia / MS		AR25/hMS	\$7.50
	Pre-roasting (ashing) to remove graphitic / other organic material		R/	\$3.00

Cyanide Leaches

Cyanide extractable gold analysis is used in a range of applications from identification of low level anomalies by BLEG in grassroots exploration to accelerated leaches mimicking metallurgical recovery processes.

BLEG (Bulk Leach Extractable Gold) – Low Level Gold

BLEG is usually performed on screened stream sediment samples, providing detection of low level anomalies for regional exploration. Large sample sizes and low dissolution of non-analyte elements facilitate ultra-low detection limits.

Element	Description	Detection Limit	Code	Price
Au	100g leach / ICP-MS	0.01ppb	CN100/MS	\$13.50
	500g leach / ICP-MS		CN500/MS	\$16.00
	1.0kg leach / ICP-MS		CN1000/MS	\$18.00
	2.0kg leach / ICP-MS		CN2000/MS	\$21.50
	4.0kg leach / ICP-MS		CN4000/MS	\$32.00
Additional Elements	Ag (0.1ppb), As (0.02ppm), Bi (0.1 ppb), Cd (0.1ppb), Co (0.001ppm), Cu (0.01ppm), Mo (0.1ppb), Ni (0.01ppm), Pd (0.1ppb), Pt (0.1ppb), Zn (0.05ppm)		per element	\$0.75

Accelerated Cyanide Leach LeachWELL™

High grade cyanide leaches utilise the LeachWELL™ accelerant to determine the cyanide extractable gold and provide an indication of potential recoveries in metallurgical processes and circuits. Recovery and analysis of the residues provide the option of reporting total gold values and thus determining the refractory gold fraction.

Element	Description	Detection Limit	Code	Price
Au	200g leach / ICP-MS	0.01ppm	LW200/MS	\$10.50
	400g leach / ICP-MS		LW400/MS	\$12.00
	1000g leach / ICP-MS		LW1000/MS	\$18.50
Ag	As an additional element	1ppm	/MS	\$0.75
Cu	Cu an additional element	5ppm	/MS	\$0.75

Tail recovery, the entire tail is washed, re-homogenised and analysed by fire assay for Au:

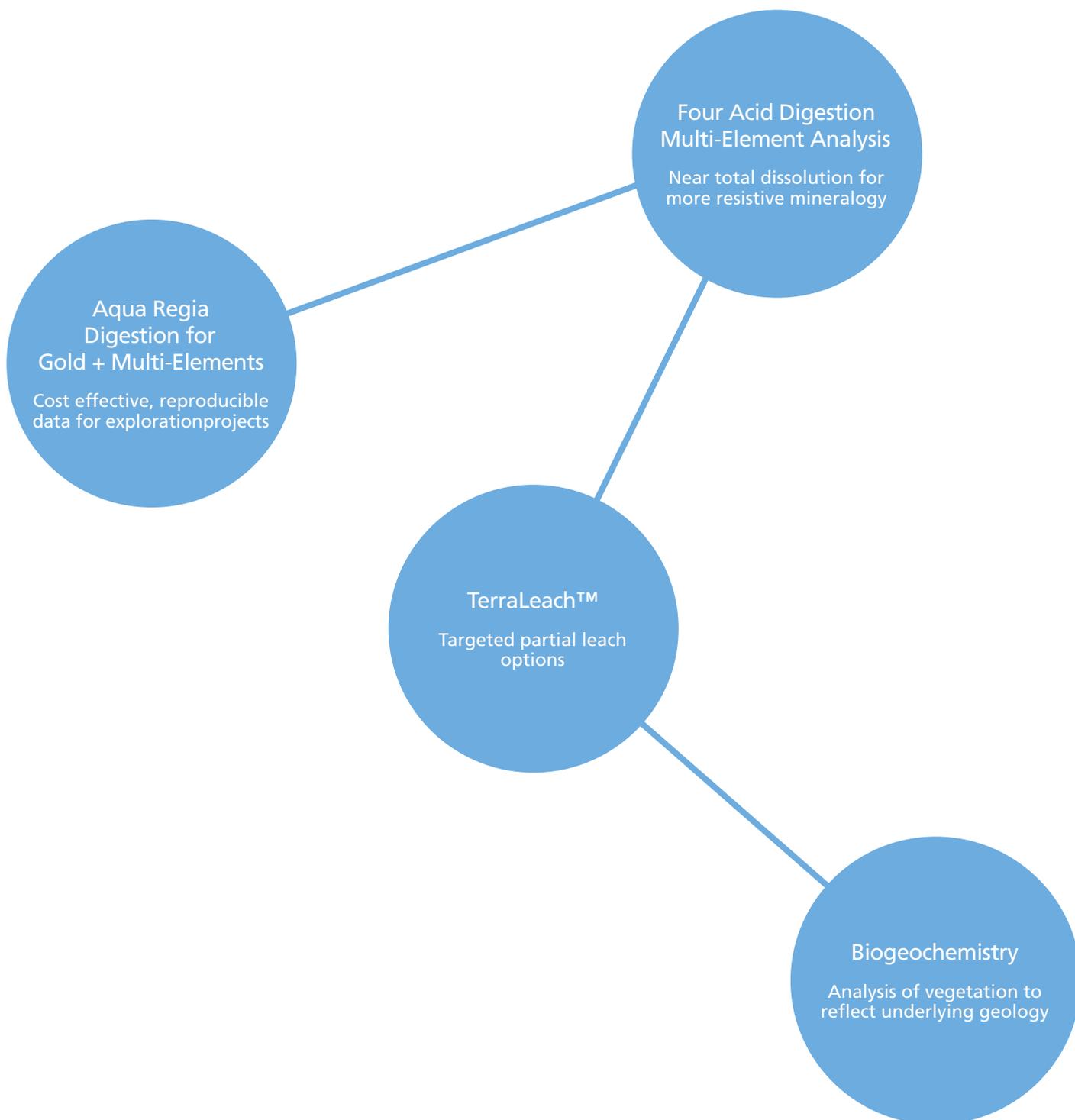
Element	Description	Detection Limit	Code	Price
Au	200g wash / grind / fire assay / ICP-OES	0.01ppm	TR200/OE	\$23.00
	400g wash / grind / fire assay / ICP-OES		TR400/OE	\$23.25
	1000g wash / grind / fire assay / ICP-OES		TR1000/OE	\$26.50

Exploration Geochemistry

The challenge of identifying geochemical anomalies related to concealed mineral deposits has driven innovation and development in analytical geochemistry.

Advances in instrumentation and methodology offer significant improvements in aligning detection limits with elemental crustal abundances and provide exceptional long term data reproducibility.

A number of exploration methods are offered including partial selective leaches, biogeochemical analyses, aqua regia digestions and near-total four acid digestions. The selection of the most appropriate method is critical to achieving the most successful outcome for your exploration project.



Aqua Regia Digestion for Gold + Multi-Elements

The advent of new analytical instrumentation technologies coupled with streamlined, ultra clean aqua-regia digestion methods provide the best platform for fast, cost effective and consistent trace level analysis for your exploration samples.

The aqua regia digestion is a classical empirical digestion technique with successful global application in geochemical exploration. Most oxide, sulphide and carbonate minerals are digested, however, refractory minerals and most silicates may be only partially decomposed. Recovery levels will vary between the elements and sample matrices with indicative recoveries highlighted on the package tables.

Samples containing graphitic or organic material may require roasting prior to digestion.

Ultimate Exploration Package

Aqua Regia Ultima 53 Element Package

An emphasis on long term consistency of quality and meaningful ultra-low level geochemical data.

Detection limits are commensurate with the crustal abundance of almost all elements, allowing for the identification of subtle geochemical trends, delineation of low level anomalies and coupled with unsurpassed long term precision, the digest facilitates seamless geochemical mapping by eliminating batch effects in spatial geochemical data.

Bundled with a portable XRF scan and the option of a REE add-on this is the Ultimate Exploration Package.

Element	Range ppm	Element	Range ppm	Element	Range ppm
Ag	0.02 - 250	Hf	0.01 - 1000	S	500 - 5%
Al	0.005% - 10 %	Hg	0.01 - 100	Sb	0.02 - 5000
As	0.05 - 5000	In	0.01 - 1000	Sc	0.02 - 2500
Au	0.1ppb - 500ppb	K	0.001% - 5%	Se	0.05 - 5000
B	5 - 1%	La	0.002 - 2500	Sn	0.05 - 1000
Ba	0.05 - 2000	Li	0.05 - 2500	Sr	0.05 - 5000
Be	0.02 - 1000	Mg	0.001% - 20%	Ta	0.01 - 1000
Bi	0.02 - 5000	Mn	0.2 - 2%	Te	0.02 - 1000
Ca	0.005% - 40 %	Mo	0.02 - 5000	Th	0.005 - 2500
Cd	0.005 - 1000	Na	0.001% - 5%	Ti	5 - 1%
Ce	0.002 - 5000	Nb	0.05 - 1000	Tl	0.01 - 1000
Co	0.01 - 1%	Ni	0.1 - 2%	U	0.005 - 5000
Cr	0.2 - 2%	P	10 - 2%	V	0.5 - 1%
Cs	0.01 - 1000	Pb	0.2 - 5000	W	0.02 - 1000
Cu	0.05 - 2%	Pd	1ppb - 500ppb	Y	0.01 - 2000
Fe	0.001% - 50 %	Pt	1ppb - 500ppb	Zn	0.2 - 2%
Ga	0.1 - 1000	Rb	0.02 - 1000	Zr	0.05 - 1000
Ge	0.05 - 1000	Re	0.001 - 500		

Aqua regia digestion 0.5g / ICP-MS AR005/MS53 \$22.50

Element	Range ppm	Element	Range ppm	Element	Range ppm
Pr	0.002 - 1000	Gd	0.002 - 1000	Er	0.002 - 1000
Nd	0.002 - 1000	Tb	0.002 - 1000	Tm	0.002 - 1000
Sm	0.002 - 1000	Dy	0.002 - 1000	Yb	0.002 - 1000
Eu	0.002 - 1000	Ho	0.002 - 1000	Lu	0.002 - 1000

Add additional REE AR005/MS53R \$6.75

Element

Ag, As, Bi, Cd, Cl, Cr, Cu, Fe, Hg, K, Mn, Mo, Ni, P, Pb, Rb, S, Sb, Se, Sn, Sr, Th, Ti, U, V, W, Y, Zn and Zr.

Portable XRF scan Add On pXscan \$3.50

Description	Code	Price
Bundled Ultima package (65 elements and pXRF scan)	ARpX01	\$30.00

Legend

Complete recovery for most samples Near complete recovery for most samples Not complete recovery

Aqua Regia Digestion Packages

Aqua regia digestion coupled with ICP-OES and ICP-MS offers a cost effective option for gold and multi-element packages.

The 1g options are primarily intended as a multi-element scanning tool. The precious metal results may be indicative only and should be interpreted with caution owing to the deportment of these elements in geological many sample types. Larger sample masses (e.g. 10g or 25g) can offer a more reliable precious metal analysis. Individual elements are available on request.

Aqua Regia 32 Element Package

Element	Range ppm	Element	Range ppm	Element	Range ppm
Ag	0.5 - 250	Cu	1 - 2%	S	50 - 5%
Al	20 - 10%	Fe	0.01% - 50%	Sb	2 - 5000
As	5 - 5000	K	20 - 5%	Sc	1 - 2500
B	10 - 1%	La	20 - 2500	Sr	1 - 5000
Ba	2 - 2000	Mg	0.01% - 20%	Te	2 - 1000
Bi	2 - 5000	Mn	1 - 2%	Ti	5 - 1%
Ca	0.01% - 40%	Mo	1 - 5000	Tl	5 - 1000
Cd	0.5 - 1000	Na	0.01% - 5%	V	2 - 5000
Ce	20 - 5000	Ni	1 - 2%	W	2 - 1000
Co	1 - 1%	P	20 - 2%	Zn	1 - 2%
Cr	2 - 1%	Pb	1 - 5000		
Aqua regia digestion 1g			AR1/OE32	\$13.50	
Aqua regia digestion 10g			AR10/OE32	\$14.25	
Aqua regia digestion 25g			AR25/OE32	\$17.25	

Aqua Regia 33 Element including Gold Package

Element	Range ppm	Element	Range ppm	Element	Range ppm
Au	1ppb - 500ppb	Cr	1 - 1%	Pb	0.5 - 5000
Ag	0.05 - 250	Cu	1 - 2%	S	500 - 5% (50 - 5%)
Al	20 - 10%	Fe	0.01% - 50%	Sb	0.05 - 5000
As	1 - 5000	K	20 - 5%	Sc	1 - 2500
B	10 - 1%	La	0.01 - 2500	Sr	0.2 - 5000
Ba	1 - 2000	Mg	0.01% - 20%	Te	0.1 - 1000
Bi	0.05 - 5000	Mn	1 - 2%	Ti	5 - 1%
Ca	0.01% - 40%	Mo	0.1 - 5000	Tl	0.05 - 1000
Cd	0.05 - 1000	Na	0.01% - 5%	V	2 - 5000
Ce	0.01 - 5000	Ni	1 - 2%	W	0.1 - 1000
Co	0.1 - 1%	P	20 - 2%	Zn	1 - 2%
Aqua regia digestion 1g / ICP-MS			AR1/MS33	\$16.50	
Aqua regia digestion 10g / ICP-MS			AR10/MS33	\$17.25	
Aqua regia digestion 25g / ICP-MS			AR25/MS33	\$20.25	
Low S (50ppm) Option					
Aqua regia digestion 1g			AR1/OM33	\$19.50	
Aqua regia digestion 10g			AR10/OM33	\$20.25	
Aqua regia digestion 25g			AR25/OM33	\$23.25	

Instrument finish may vary between locations.

Au 0.01ppm, 0.1ppb options also available on request.

Legend

Complete recovery for most samples

Near complete recovery for most samples

Not complete recovery

Aqua Regia 52 Element Package

Element	Range ppm	Element	Range ppm	Element	Range ppm
Au	1ppb - 500ppb	Hg	0.1 - 100	Sb	0.02 - 5000
Ag	0.05 - 250	In	0.01 - 1000	Sc	0.1 - 2500
Al	20 - 10%	K	20 - 5%	Se	1 - 5000
As	1 - 5000	La	0.005 - 2500	Sn	0.05 - 1000
B	10 - 1%	Li	0.1 - 2500	Sr	0.02 - 5000
Ba	1 - 2000	Mg	0.01% - 20%	Ta	0.01 - 1000
Be	0.05 - 1000	Mn	1 - 2%	Te	0.1 - 1000
Bi	0.01 - 5000	Mo	0.1 - 5000	Th	0.01 - 2500
Ca	0.01% - 40%	Na	0.01% - 5%	Ti	5 - 1%
Cd	0.01 - 1000	Nb	0.02 - 1000	Tl	0.01 - 1000
Ce	0.005 - 5000	Ni	0.5 - 2%	U	0.01 - 5000
Co	0.1 - 1%	P	20 - 2%	V	2 - 5000
Cr	1 - 2%	Pb	0.5 - 5000	W	0.05 - 1000
Cs	0.01 - 1000	Pd	10ppb - 500ppb	Y	0.02 - 2000
Cu	0.5 - 2%	Pt	5ppb - 500ppb	Zn	1 - 2%
Fe	0.01% - 50%	Rb	0.02 - 1000	Zr	0.1 - 1000
Ga	0.05 - 500	Re	0.001 - 500		
Hf	0.01 - 1000	S	500 - 5% (50-5%*)		
Aqua regia digestion 1g			AR1/MS52	\$23.25	
Aqua regia digestion 10g			AR10/MS52	\$24.00	
Aqua regia digestion 25g			AR25/MS52	\$27.00	
Low S (50ppm) Option*					
Aqua regia digestion 1g			AR1/OM52	\$26.25	
Aqua regia digestion 10g			AR10/OM52	\$27.00	
Aqua regia digestion 25g			AR25/OM52	\$30.00	

Instrument finish may vary between locations.
Au 0.01ppm, 0.1ppb options available on request

Rare Earth Elements (REE) 12 Element Add On

Additional rare earth elements are available as a supplementary package to the AR1, AR10 and AR25 digestion packages.

Element	Range ppm	Element	Range ppm	Element	Range ppm
Pr	0.005 - 2500	Gd	0.005 - 1000	Er	0.005 - 1000
Nd	0.005 - 2500	Tb	0.005 - 1000	Tm	0.005 - 1000
Sm	0.005 - 2500	Dy	0.005 - 1000	Yb	0.005 - 1000
Eu	0.005 - 1000	Ho	0.005 - 1000	Lu	0.005 - 1000
REE add on			*/MS52R or */OM52R	\$6.75	

Detection limits may vary between locations.

Aqua Regia Digestion Individual Elements

A selection of individual elements is offered to enable suites to be customised to suit your specific needs, or where only a few elements are required.

Description	Code	Price
Aqua regia digestion 1g	/ ICP first element AR1/OM	\$9.00
Aqua regia digestion 10g	/ ICP first element AR10/OM	\$10.50
Aqua regia digestion 25g	/ ICP first element AR25/OM	\$13.50
Aqua regia digestion 1g, 10g, 25g	/ secondary instrument first element	\$5.50
	/ per additional element	\$0.50
Au as an additional element	10g or 25g options / MS (0.01ppm) AR10 or AR25/hMS01	\$2.00
Au as an additional element	10g or 25g options / MS (1ppb) AR10 or AR25/aMS01	\$3.00
Au as an additional element	10g or 25g options / enhanced MS (0.1ppb) AR10 or AR25/eMS01	\$5.50

Four Acid Digestion Multi-Element Analysis

Four acid digestion offers a “near total” dissolution of almost all minerals species, targeting silicates not dissolved in less aggressive aqua regia digests. Carefully staged digestion steps minimise losses due to volatilisation of some elements.

Highly resistant refractory minerals such as zircon, cassiterite, columbite-tantalite, ilmenite, xenotime rutile, barite and wolframite will require a fusion digestion to guarantee complete dissolution.

Packages range from basic ICP-OES only suites through to a comprehensive element list utilising both ICP-OES and ICP-MS for ultra-trace levels. Individual elements are available on request.

Four Acid 33 Element Package

Element	Range ppm	Element	Range ppm	Element	Range ppm
Ag	0.5 - 500	Fe	100 - 50%	S	50 - 10%
Al	50 - 15%	K	20 - 10%	Sb	5 - 1%
As	10 - 1%	La	20 - 5000	Sc	1 - 5000
Ba	2 - 5000	Li	1 - 5000	Sn	5 - 2000
Bi	5 - 1%	Mg	20 - 40%	Sr	1 - 1%
Ca	50 - 40%	Mn	1 - 5%	Te	5 - 2000
Cd	0.5 - 2000	Mo	2 - 1%	Ti	5 - 2%
Ce	20 - 1%	Na	20 - 10%	Tl	10 - 2000
Co	1 - 2%	Ni	1 - 2%	V	1 - 2%
Cr	5 - 2%	P	50 - 5%	W	5 - 2000
Cu	1 - 2%	Pb	5 - 1%	Zn	1 - 2%

4A/OE33 \$16.50

Four Acid 48 Element Package

Element	Range ppm	Element	Range ppm	Element	Range ppm
Ag	0.05 - 500	Hf	0.05 - 2000	Sb	0.05 - 1%
Al	50 - 15%	In	0.01 - 2000	Sc	0.1 - 5000
As	0.5 - 1%	K	20 - 10%	Se	0.5 - 1%
Ba	0.1 - 5000	La	0.01 - 5000	Sn	0.1 - 2000
Be	0.05 - 2000	Li	0.1 - 5000	Sr	0.05 - 1%
Bi	0.01 - 1%	Mg	20 - 40%	Ta	0.01 - 2000
Ca	50 - 40%	Mn	1 - 5%	Te	0.2 - 2000
Cd	0.02 - 2000	Mo	0.1 - 1%	Th	0.01 - 5000
Ce	0.01 - 1%	Na	20 - 10%	Ti	5 - 2%
Co	0.1 - 2%	Nb	0.05 - 2000	Tl	0.02 - 2000
Cr	1 - 2%	Ni	0.5 - 2%	U	0.01 - 1%
Cs	0.05 - 2000	P	50 - 5%	V	1 - 2%
Cu	0.5 - 2%	Pb	0.5 - 1%	W	0.1 - 2000
Fe	100 - 50%	Rb	0.05 - 2000	Y	0.05 - 2000
Ga	0.05 - 2000	Re	0.002 - 2000	Zn	1 - 2%
Ge	0.1 - 2000	S	500 - 10% (50 - 10%*)	Zr	0.1 - 2000

4A/MS48 \$27.00
4A/OM48 \$30.00

Low level S 50ppm option*

Rare Earth 12 Elements Add On

Rare earth elements are available as a supplementary package.

Element	Range ppm	Element	Range ppm	Element	Range ppm
Pr	0.01 - 5000	Gd	0.01 - 2000	Er	0.01 - 2000
Nd	0.01 - 5000	Tb	0.01 - 2000	Tm	0.01 - 2000
Sm	0.01 - 5000	Dy	0.01 - 2000	Yb	0.01 - 2000
Eu	0.01 - 2000	Ho	0.01 - 2000	Lu	0.01 - 2000

4A/MS48R or 4A/OM48R \$6.75

Four Acid Digest Individual Elements

A selection of individual elements is offered to enable suites to be customised to suit your specific needs, or where only a few elements are required.

Description	Code	Price
4 acid digestion	/ ICP first element	\$11.65
	/ secondary instrument first element	\$5.50
	/ per additional element	\$0.50

TerraLeach™ Partial Digest Geochemistry

Partial selective digests are carried out on soil media to detect mineralisation under cover in areas where conventional geochemistry may be ineffective. Buried ore bodies may release trace levels of metals into groundwater which are inferred to travel vertically in the overlying substrate and accumulate in the top portion of the soil profile where they are added to the background metal concentrations.

Targeted metal ions generally reside on the surfaces of soil particles requiring only weak selective digest to remove them, thus producing a superior anomaly to background contrast. This differentiates partial digests from stronger leaches which also extract occluded substrate metal ions that contribute to background levels of metal, resulting in an inferior anomaly contrast.

A range of partial digests are offered designed to target certain element suites and specific element species. Detection limits may vary as a consequence of the sample media. Before commencing any new partial digest program we recommend consultation with our Geochemist. An orientation survey to help select the optimum sample media and digestion technique is strongly recommended.

The following partial selective digests are currently offered:

TerraLeach Digest TL1.

An alkaline cyanide digest for gold and associated pathfinder elements.

TerraLeach Digest TL4

A weak acid EDTA digest designed for copper, lead and zinc. This digest is ideal for base metals in alkaline (limestone or dolomite derived) soils.

TerraLeach Digest TL6.

A weak cyanide alkaline digest for predominantly chemical and ultra-fine gold, however only minor dissolution of particulate gold is achieved.

TerraLeach Digest TL7.

A moderate strength hydrochloric acid digest designed to digest amorphous Fe and Mn oxide/hydroxides.

TerraLeach Digest TL8.

An alkaline carbonate digest for uranium and associated pathfinders containing cyanide for enhanced recovery of gold. Refractory uranium species are not recovered.

TerraLeach Digest TL9.

A sodium pyrophosphate digest for the recovery of elements in humic acid. Cyanide enhances gold recovery.

Partial Digest 19 Element Package

Element	DL ppb		Element	DL ppb		Element	DL ppb				
	TL1	TL6 TL8		TL7	TL1		TL6 TL8	TL7	TL1	TL6 TL8	TL7
Ag	0.2		2	La	0.5		5	Sn	2		20
As	2		20	Mo	1		10	Th	0.1		1
Au	0.05		0.5	Ni	0.02ppm		0.2ppm	U	0.1		1
Bi	0.5		5	Pb	0.02ppm		0.2ppm	W	10		100
Cd	0.5		5	Pd	1		10	Zn	0.2ppm		0.2ppm
Co	2		20	Pt	0.2		2				
Cu	0.02ppm		0.2ppm	Sb	0.5		2				

TL1, TL6, TL7 or TL8/MS19

\$28.00

Partial Digest 28 Element Package

Element	DL ppb		Element	DL ppb		Element	DL ppb				
	TL1	TL6 TL8		TL7	TL1		TL6 TL8	TL7	TL1	TL6 TL8	TL7
Ag	0.2		2	K	1ppm		2ppm	S	2ppm		2ppm
As	2		20	La	0.5		5	Sb	0.5		2
Au	0.05		0.5	Mg	0.2ppm		2ppm	Sn	2		20
Bi	0.5		5	Mn	0.2ppm		0.5ppm	Th	0.1		1
Ca	0.2ppm		2ppm	Mo	1		10	U	0.1		1
Cd	0.5		5	Ni	0.02ppm		0.2ppm	V	0.2ppm		0.2ppm
Co	2		20	P	2ppm		2ppm	W	10		100
Cr	0.2ppm		2ppm	Pb	0.02ppm		0.2ppm	Zn	0.2ppm		0.2ppm
Cu	0.02ppm		0.2ppm	Pd	1		10				
Fe	0.2ppm		2ppm	Pt	0.2		2				

TL1, TL6, TL7 or TL8/OM28

\$33.00

Legend

Complete recovery for most samples

Near complete recovery for most samples

Not complete recovery

Partial Digest 59 Element Package

Element	DL ppb		Element	DL ppb		Element	DL ppb	
	TL1 TL6 TL8	TL7		TL1 TL6 TL8	TL7		TL1 TL6 TL8	TL7
Ag	0.2	2	Ho	0.5	5	Sc	0.2ppm	0.2ppm
Al	0.2ppm	2ppm	In	0.1	1	Se	5	50
As	2	20	K	0.2ppm	2ppm	Si	1ppm	5ppm
Au	0.05	0.5	La	0.5	5	Sm	0.5	5
Ba	0.02ppm	0.2ppm	Li	1	10	Sn	2	20
Be	2	20	Lu	0.5	5	Ta	0.1	1
Bi	0.5	5	Mg	0.2ppm	2ppm	Tb	0.05	0.5
Ca	0.2ppm	2ppm	Mn	0.2ppm	0.5ppm	Te	2	20
Cd	0.5	5	Mo	1	10	Th	0.1	1
Ce	1	10	Na	–*	1ppm	Ti	0.2ppm	1ppm
Co	2	20	Nb	0.1	1	Tl	0.2	2
Cr	0.2ppm	0.2ppm	Nd	0.5	5	Tm	0.5	5
Cu	0.02ppm	0.2ppm	Ni	0.02ppm	0.2ppm	U	0.1	1
Dy	0.5	5	P	2ppm	2ppm	V	0.2ppm	0.2ppm
Er	0.5	5	Pb	0.02ppm	0.2ppm	W	10	100
Eu	0.5	5	Pd	1	10	Y	1	10
Fe	0.2ppm	2ppm	Pr	0.5	5	Yb	0.1	1
Ga	0.5	5	Pt	0.2	2	Zn	0.2ppm	0.2ppm
Ge	1	10	S	2ppm	2ppm	Zr	0.5	5
Hf	0.5	5	Sb	0.5	2			

TL1, TL6, TL7 or TL8/OM59 *Na is only reported on TL7 digest

\$41.00

Partial Digest Individual Elements

A selection of individual elements is offered to enable suites to be customised to suit your specific needs or where only a few elements are required.

Description	Code	Price
TerraLeach	/ ICP first element	\$15.00
	/ secondary instrument first element	\$6.50
	/ per additional ICP element	\$0.75

Legend

Complete recovery for most samples	Near complete recovery for most samples	Not complete recovery
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Biogeochemistry

The analysis of plant tissue can be used as a guide to the underlying geology, and is particularly useful in areas of transported cover. Biogeochemical samples are easy and cheap to collect as well as having a low environmental impact. All plant tissue (foliage, twigs, bark, flowers, seeds, litter) can be analysed, however, foliage and bark give the strongest geochemical signature in most cases. An orientation study to determine the most useful species and tissue type to sample is recommended and specific sampling techniques should be followed. Please contact the laboratory for detailed instructions.

Biogeochemistry Sample Preparation

Various preparation options are available for our biogeochemistry analysis packages.

Description	Code	Price
Sorting and stripping of twigs and leaves per 100g	BGSS	\$7.50
Vegetation sample preparation (Retsch Mills)	BGMD01	\$5.50
Double milling and drying of hard plant tissue	BGMD02	\$11.25

Biogeochemistry 33 Element Package

Element	Range ppm	Element	Range ppm	Element	Range ppm
Ag	5ppb - 10	Fe	5 - 5%	S	5 - 1%
Al	5 - 2%	Ga	0.01 - 200	Sb	5ppb - 500
As	0.1 - 1000	Hg	2ppb - 50	Sn	0.02 - 50
Au	0.5ppb - 10	In	1ppb - 50	Ta	2ppb - 50
Be	5ppb - 50	La	2ppb - 200	Te	5ppb - 50
Bi	2ppb - 100	Mo	0.02 - 200	Th	5ppb - 200
Cd	2ppb - 50	Ni	0.1 - 2000	Tl	2ppb - 50
Ce	5ppb - 200	Pb	0.02 - 1000	U	0.5ppb - 2000
Co	0.02 - 200	Pd	2ppb - 10	V	0.2 - 500
Cr	0.2 - 500	Pt	1ppb - 10	W	0.02 - 50
Cu	0.1 - 5000	Re	0.5ppb - 50	Zn	0.2 - 2000
BG/OM03				\$22.00	

Biogeochemistry 64 Element Package

Modified aqua regia digest coupled with ICP-MS finish

Element	Range ppm	Element	Range ppm	Element	Range ppm
Ag	2ppb - 10	Hg	5ppb - 50	Sb	5ppb - 500
Al	20 - 2%	Ho	2ppb - 50	Sc	0.01 - 200
As	0.05 - 1000	In	2ppb - 50	Se	0.05 - 50
Au	0.2ppb - 10	K	5 - 5%	Sm	2ppb - 200
B	2 - 1000	La	2ppb - 200	Sn	0.02 - 50
Ba	0.05 - 1%	Li	0.02 - 500	Sr	0.02 - 2000
Be	20ppb - 50	Lu	2ppb - 50	Ta	5ppb - 50
Bi	2ppb - 100	Mg	10 - 2%	Tb	2ppb - 50
Ca	20 - 5%	Mn	0.2 - 2000	Te	5ppb - 50
Cd	5ppb - 50	Mo	0.02 - 200	Th	5ppb - 200
Ce	5ppb - 200	Na	20 - 5%	Ti	0.5 - 500
Co	0.02 - 200	Nb	5ppb - 50	Tl	2ppb - 50
Cr	0.2 - 500	Nd	2ppb - 200	Tm	2pb - 50
Cs	2ppb - 50	Ni	0.2 - 2000	U	1ppb - 2000
Cu	0.05 - 5000	P	5 - 5000	V	0.2 - 500
Dy	2ppb - 50	Pb	0.05 - 1000	W	0.02 - 50
Er	2ppb - 50	Pd	2ppb - 10	Y	2ppb - 50
Eu	2ppb - 50	Pr	2ppb - 200	Yb	2ppb - 50
Fe	10 - 5%	Pt	2ppb - 10	Zn	0.2 - 2000
Ga	0.01 - 200	Rb	0.01 - 500	Zr	0.02 - 50
Gd	2ppb - 50	Re	1ppb - 50		
Hf	2ppb - 50	S	100 - 1%		
BG/MS64				\$37.00	

Ores & Commodities

A diverse suite of procedures provide optimum precision and accuracy of the target element typically required in advanced exploration and resource evaluation. Techniques include multi-acid and fusion digests, useful for characterisation of geological samples where total dissolution of the sample is required, coupled with ICP-OES, ICP-MS and XRF instrumentation.

Trade commercial grade sample analysis where results are used for umpire or commercial settlement are available on request, see the Minerals Trade Services section on page 39.

Ores and High Grade Materials

Acid Digestion

High grade sulphide ores are readily quantified using a 4 acid digest formulated to retain low-solubility elements such as Pb and Ag in solution at higher concentrations. This is a near total dissolution however elements incorporated in high refractory minerals may not be completely digested. The use of ICP-OES and ICP-MS allows for the accurate determination of the major ore chemistry as well as the low level characterisation of the deleterious trace elements and precious metals such as Ag.

Four Acid Low Grade Mineralisation Package

Element	Range ppm	Element	Range ppm	Element	Range ppm
Ag	2 - 500	Fe	100 - 50%	S	50 - 10%
Al	50 - 15%	K	50 - 10%	Sb	10 - 1%
As	10 - 1%	La	20 - 5000	Sc	1 - 5000
Ba	2 - 5000	Li	5 - 5000	Sn	10 - 2000
Bi	10 - 1%	Mg	50 - 40%	Sr	1 - 1%
Ca	50 - 40%	Mn	5 - 5%	Te	10 - 2000
Cd	2 - 2000	Mo	5 - 1%	Ti	5 - 2%
Ce	20 - 1%	Na	50 - 10%	Tl	5 - 2%
Co	5 - 2%	Ni	5 - 5%	V	5 - 2%
Cr	10 - 2%	P	50 - 5%	W	10 - 2000
Cu	5 - 5%	Pb	10 - 1%	Zn	5 - 5%
4AM/OE33				\$16.50	

Ore Grade Digestion Individual Elements

Element	Range ppm	Element	Range ppm	Element	Range ppm
Ag	2 - 5000	Fe	100 - 70%	Sb	20 - 10%
Al	100 - 15%	Li	5 - 5%	Sc	5 - 1%
As	20 - 20%	Mg	100 - 60%	Sr	5 - 10%
Ba	10 - 2%	Mn	5 - 50%	Te	20 - 2%
Bi	20 - 10%	Mo	5 - 10%	Ti	20 - 5%
Ca	100 - 50%	Na	100 - 20%	Tl	20 - 2%
Cd	5 - 5%	Ni	5 - 70%	V	10 - 5%
Co	5 - 20%	P	100 - 50%	Y	5 - 1%
Cr	20 - 5%	Pb	20 - 50%	Zn	5 - 70%
Cu	5 - 70%	S	100 - 60%	Zr	5 - 2000
Ore grade 4 acid digest / ICP-OES first element			4AO/OM		\$13.50
/ per additional element					\$0.50

Fusion Decomposition

Two principal fusion methods are offered, lithium borate fusions in platinum crucibles and sodium peroxide fusions in either nickel or zirconium crucibles. Fusion methods digest all major rock forming minerals, including many that resist acid digestion. Once dissolved, the fusion product can be analysed by either ICP-OES or ICP-MS. Borate fusions are suitable for quantification of the major oxide components of geological samples and many trace elements. Peroxide fusions are more robust than borate fusions and are used routinely with sulphide ores. Sodium, the crucible element and a small suite of other elements are not available with peroxide fusions.

Specific commodity packages are found from page 25.

Lithium Borate Fusion

Lithium borate fusion offers a high temperature aggressive digest suitable for almost all geological samples. The technique is optimised for accuracy at both high and low element concentrations. Major element analysis can be carried out with either ICP or XRF finishes. The whole rock packages are available on Pg 34 and can be coupled with selected minor and trace elements listed below. Results for Co and, Mo, are semi quantitative only by this fusion method.

Samples containing high sulphides (2%), elevated copper (1%) and other reduced species such as metallics, arsenides, carbides and carbon should be analysed using the sodium peroxide fusion options. Specialised methods on page 30 should be utilised where the REE oxide content exceeds 1%.

Lithium Borate Individual Elements by ICP-OES / ICP-MS

Element	Range ppm	Finish	Element	Range ppm	Finish	Element	Range ppm	Finish
Al ₂ O ₃	0.01 - 100%	ICP-OES	Ho	0.1 - 2%	ICP-MS	SiO ₂	0.01% - 100%	ICP-OES
Ba	0.5 - 5%	ICP-MS	K ₂ O	0.01% - 100%	ICP-OES	Sm	0.1 - 10%	ICP-MS
Be	0.5 - 2%	ICP-MS	La	0.2 - 20%	ICP-MS	Sn	1 - 5%	ICP-MS
CaO	0.01% - 100%	ICP-OES	Lu	0.1 - 1%	ICP-MS	Sr	0.2 - 20%	ICP-MS
Ce	0.5 - 30%	ICP-MS	MgO	0.01% - 100%	ICP-OES	Ta	0.1 - 5%	ICP-MS
Co	0.5 - 10%	ICP-MS	MnO	0.01% - 100%	ICP-OES	Tb	0.1 - 2%	ICP-MS
Cr	20 - 5%	ICP-OES	Mo	1 - 1%	ICP-MS	Th	0.1 - 2%	ICP-MS
Cs	0.1 - 1%	ICP-MS	Na ₂ O	0.01% - 100%	ICP-OES	TiO ₂	0.01% - 100%	ICP-OES
Dy	0.1 - 5%	ICP-MS	Nb	0.1 - 5%	ICP-MS	Tm	0.1 - 1%	ICP-MS
Er	0.1 - 5%	ICP-MS	Nd	0.1 - 20%	ICP-MS	U	0.1 - 30%	ICP-MS
Eu	0.1 - 5%	ICP-MS	P ₂ O ₅	0.01% - 100%	ICP-OES	V	10 - 5%	ICP-OES
Fe ₂ O ₃	0.01% - 100%	ICP-OES	Pr	0.1 - 10%	ICP-MS	W	1 - 5%	ICP-MS
Ga	0.5 - 5%	ICP-MS	Rb	0.1 - 5%	ICP-MS	Y	0.5 - 50%	ICP-MS
Gd	0.1 - 5%	ICP-MS	Sb	0.5 - 2%	ICP-MS	Yb	0.1 - 5%	ICP-MS
Hf	0.1 - 5%	ICP-MS	Sc	10 - 5%	ICP-OES	Zr	1 - 50%	ICP-MS
Lithium borate fusion / ICP first element					FB6/OM			
/ secondary instrument first element						\$18.75		
/ per additional element						\$7.50		
						\$0.75		

Legend

Complete recovery for most samples

Near complete recovery for most samples

Not complete recovery

Sodium Peroxide Fusions

Sodium peroxide fusions offer total dissolution of the sample and can be performed in either nickel or zirconium crucibles to preclude the presence of unwanted contaminant metals thus allowing different element suites to be tailored for various purposes. Sodium peroxide fusions are useful for samples in which the elements of interest are hosted in minerals that may resist acid digestions. These include, amongst others, minerals and ores containing rare earth elements (REE) and the high field strength elements (HFSE), Sn, W, Ti, Ta, Nb and V.

Zirconium Crucible Fusion Individual Elements by ICP-OES & ICP-MS Suitable for Majors, Boron and Base Metals

Element	Range ppm	Finish	Element	Range ppm	Finish	Element	Range ppm	Finish
Al	100 - 50%	ICP-OES	In	0.1 - 5%	ICP-MS	Si	0.1% - 50%	ICP-OES
As	20 - 20%	ICP-MS	K	500 - 20%	ICP-OES	Sn	100 - 50%	ICP-MS
B	50 - 10%	ICP-OES	Li	1 - 20%	ICP-MS	Sr	20 - 20%	ICP-MS
Ba	1 - 2%	ICP-MS	Mg	100 - 60%	ICP-OES	Ta	0.1 - 50%	ICP-MS
Be	1 - 2%	ICP-MS	Mn	20 - 75%	ICP-OES	Te	2 - 2%	ICP-MS
Bi	0.1 - 10%	ICP-MS	Mo	1 - 10%	ICP-MS	Th	0.1 - 2%	ICP-MS
Ca	0.1% - 70%	ICP-OES	Nb	2 - 30%	ICP-MS	Ti	100 - 60%	ICP-OES
Cd	10 - 5%	ICP-MS	Ni	20 - 70%	ICP-OES	Tl	0.5 - 2%	ICP-MS
Co	1 - 20%	ICP-MS	Pb	20 - 70%	ICP-MS	U	0.1 - 60%	ICP-MS
Cr	50 - 40%	ICP-OES	Rb	0.5 - 5%	ICP-MS	V	20 - 20%	ICP-OES
Cs	0.1 - 1%	ICP-MS	Re	0.1 - 1%	ICP-MS	W	1 - 50%	ICP-MS
Cu	20 - 70%	ICP-OES	S	500 - 60%	ICP-OES	Y	0.5 - 50%	ICP-MS
Fe	100 - 75%	ICP-OES	Sb	0.5 - 10%	ICP-MS	Zn	20 - 70%	ICP-OES
Ga	1 - 5%	ICP-MS	Sc	10 - 5%	ICP-OES			
Ge	1 - 0.1%	ICP-MS	Se	20 - 2%	ICP-MS			

Sodium peroxide fusion Zr crucible / ICP first element	FP1/OM	\$15.75
/ secondary instrument first element		\$6.00
/ per additional element		\$0.75

Nickel Crucible Fusion ICP-OES & ICP-MS Individual Elements Suitable for Majors and Boron

Element	Range ppm	Finish	Element	Range ppm	Finish	Element	Range ppm	Finish
Al	100 - 50%	ICP-OES	Ho	0.1 - 2%	ICP-MS	Se	20 - 2%	ICP-MS
Ag	5 - 2%	ICP-MS	In	0.1 - 5%	ICP-MS	Si	0.1% - 50%	ICP-OES
As	20 - 20%	ICP-MS	K	500 - 20%	ICP-OES	Sm	0.1 - 10%	ICP-MS
B	50 - 10%	ICP-OES	La	0.2 - 20%	ICP-MS	Sn	2 - 50%	ICP-MS
Ba	1 - 2%	ICP-MS	Li	5 - 20%	ICP-MS	Sr	20 - 20%	ICP-MS
Be	1 - 2%	ICP-MS	Lu	0.1 - 1%	ICP-MS	Ta	0.1 - 50%	ICP-MS
Bi	0.1 - 10%	ICP-MS	Mg	100 - 60%	ICP-OES	Tb	0.1 - 2%	ICP-MS
Ca	0.1% - 70%	ICP-OES	Mn	0.2% - 75%	ICP-OES	Te	1 - 2%	ICP-MS
Cd	1 - 5%	ICP-MS	Nb	10 - 30%	ICP-MS	Th	0.1 - 2%	ICP-MS
Ce	0.5 - 30%	ICP-MS	Nd	0.1 - 20%	ICP-MS	Ti	500 - 60%	ICP-OES
Cs	0.1 - 1%	ICP-MS	P	100 - 50%	ICP-OES	Tl	0.5 - 2%	ICP-MS
Dy	0.1 - 5%	ICP-MS	Pb	20 - 70%	ICP-MS	Tm	0.1 - 1%	ICP-MS
Er	0.1 - 5%	ICP-MS	Pr	0.1 - 10%	ICP-MS	U	0.1 - 60%	ICP-MS
Eu	0.1 - 5%	ICP-MS	Rb	0.5 - 5%	ICP-MS	V	50 - 20%	ICP-OES
Fe	100 - 75%	ICP-OES	Re	0.1 - 1%	ICP-MS	W	1 - 50%	ICP-MS
Ga	1 - 5%	ICP-MS	S	500 - 60%	ICP-OES	Y	0.5 - 50%	ICP-MS
Gd	0.1 - 5%	ICP-MS	Sb	0.5 - 10%	ICP-MS	Yb	0.1 - 5%	ICP-MS
Hf	0.1 - 5%	ICP-MS	Sc	10 - 5%	ICP-OES	Zr	5 - 50%	ICP-MS

Sodium peroxide fusion Ni crucible / ICP first element	FP6/OM	\$18.75
/ secondary instrument first element		\$6.00
/ per additional element		\$0.75

Specific Commodities

Iron Ore

X-ray fluorescence spectroscopy (XRF) is the preferred method of analysis for iron ore samples. Accuracy, long term reproducibility and high throughput means XRF is unparalleled in the modern geochemical laboratory for the analysis of the major components of iron ores.

Pulverised samples are fused with a lithium borate flux and cast into disks using semi or fully automated technology. The use of fusion disks eliminates physical effects such as particle size and reduces matrix effects which can compromise the accuracy of XRF analysis. High quality data is produced using either simultaneous or sequential wavelength dispersive instrumentation.

Loss on ignition (LOI) is determined by the use of thermo gravimetric analysis (TGA). Single point LOI is determined at 1000°C and is included in the iron ore packages. Customised multiple point LOI determinations are available on request.

Basic Iron Ore XRF Package

Suitable for exploration and resource modeling this suite is intended to quantify the essential major and minor oxide components of an iron ore sample.

Element	Range %	Element	Range %	Element	Range %
Fe	0.01 - 75	MgO	0.01 - 100	SiO ₂	0.01 - 100
Al ₂ O ₃	0.01 - 100	MnO	0.01 - 100	TiO ₂	0.01 - 100
CaO	0.01 - 100	Na ₂ O	0.01 - 100	V ₂ O ₅	0.005 - 10
Cr ₂ O ₃	0.005 - 10	P	0.001 - 45	LOI 1000°C	0.01 - 100
K ₂ O	0.01 - 100	S	0.001 - 40		
Li borate fusion / XRF			FB1/XRF10	\$26.00	
Multiple point LOI per additional temperature point			FB1/XRF10-1	\$2.00	

Multi-point LOI values are cumulative unless requested otherwise.

Extended Suite Packages

Suitable for exploration and resource modeling as well as quantification of additional accessory and deleterious elements. These elements are less abundant in most iron ores however, they may affect the quality of the ore if present in significant quantities.

Iron Ore Extended Suite – Standard Detection Limits XRF Package

Element	Range %	Element	Range %	Element	Range %
Fe	0.01 - 75	K ₂ O	0.01 - 100	Sn	0.005 - 5
Al ₂ O ₃	0.01 - 100	MgO	0.01 - 100	Sr	0.005 - 5
As	0.005 - 5	MnO	0.01 - 100	TiO ₂	0.01 - 100
BaO	0.005 - 5	Na ₂ O	0.01 - 100	V ₂ O ₅	0.005 - 10
CaO	0.01 - 100	Ni	0.005 - 20	Zn	0.005 - 5
Cl	0.005 - 5	P	0.001 - 45	Zr	0.005 - 5
Co	0.005 - 5	Pb	0.005 - 5	LOI 1000°C	0.01 - 100
Cr ₂ O ₃	0.005 - 10	S	0.001 - 40		
Cu	0.005 - 5	SiO ₂	0.01 - 100		
Li borate fusion / XRF			FB1/XRF11	\$30.00	
Multiple point LOI per additional temperature point			FB1/XRF11-1	\$2.00	

Multi-point LOI values are cumulative unless requested otherwise.

Legend

Complete recovery for most samples

Near complete recovery for most samples

Not complete recovery

Iron Ore Extended Suite – Low Detection Limits XRF Package Element Range

Element	Range %	Element	Range %	Element	Range %
Fe	0.01 - 75	K ₂ O	0.01 - 100	Sn	0.001 - 5
Al ₂ O ₃	0.01 - 100	MgO	0.01 - 100	Sr	0.001 - 5
As	0.001 - 5	MnO	0.01 - 100	TiO ₂	0.01 - 100
BaO	0.005 - 5	Na ₂ O	0.01 - 100	V	0.005 - 5
CaO	0.01 - 100	Ni	0.001 - 20	Zn	0.001 - 5
Cl	0.002 - 5	P	0.001 - 45	Zr	0.001 - 5
Co	0.001 - 5	Pb	0.001 - 5	LOI 1000°C	0.01 - 100
Cr	0.005 - 10	S	0.001 - 40		
Cu	0.001 - 5	SiO ₂	0.01 - 100		
Li borate fusion / XRF			FB1/XRF12	\$33.00	
Multiple point LOI per additional temperature point			FB1/XRF12-1	\$2.00	

Multi-point LOI values are cumulative unless requested otherwise.

Additional methods

Element	Description	DL	Code	Price
FeO	Acid digestion / titration	0.1%	AD71/VOL	\$37.00

Aluminium Ore (Bauxite)

XRF analysis of bauxite is the preferred method to return total values of the component oxides such as alumina and silica. A single point LOI is done at 1000°C. As bauxites are highly hygroscopic, all data is corrected to the dry sample.

Of more fundamental importance are the available alumina and reactive silica components of the bauxite ores. The available alumina is the alumina component that can be extracted using the sodium hydroxide leaching Bayer process. The reactive silica is the silica component that dissolves in the Bayer process and reacts with some of the dissolved alumina and sodium hydroxide, whereby both alumina and sodium are lost to the process. Reactive silica and available alumina are determined in dedicated bauxite laboratory at the Perth facility.

Bauxite XRF Package

Element	Range %	Element	Range %	Element	Range %
Al ₂ O ₃	0.01 - 100	MgO	0.01 - 100	TiO ₂	0.01 - 100
BaO	0.01 - 5	MnO	0.01 - 100	V ₂ O ₅	0.005 - 10
CaO	0.01 - 100	Na ₂ O	0.01 - 100	ZrO ₂	0.01 - 5
Cr ₂ O ₃	0.005 - 10	P ₂ O ₅	0.002 - 100	LOI 1000°C	0.01 - 100
Fe ₂ O ₃	0.01 - 100	SiO ₂	0.01 - 100		
K ₂ O	0.01 - 100	SO ₃	0.002 - 100		
Li borate fusion / XRF			FB1/XRF30	\$26.00	
Ga as an additional element			FB1/XRF30-1	\$28.00	

Bayer Leach Procedures

Element	Description	DL	Code	Price
AAI ₂ O ₃ , R _x SiO ₂	Hydroxide leach @ 145°C / ICP-OES*	0.10%	BX1/OE	\$16.50
Na ₂ C ₂ O ₄ , Na ₂ SO ₄	Oxalates and sulphates as additional elements by Ion Chromatography	0.01%	BX1/IC	\$20.00

* Alternate temperatures are available on request.

Bayer Leach Package

Element	Description	DL	Code	Price
AAI ₂ O ₃ , R _x SiO ₂	Hydroxide leach @ 145°C / ICP-OES*	0.10%	BX1/202	\$27.00
Na ₂ C ₂ O ₄ , Na ₂ SO ₄	Oxalates and sulphates as additional elements by Ion Chromatography	0.01%		

* Alternate temperatures are available on request.

Chromite Ore

Chromium ores are usually found associated with ultramafic rocks and may be accurately analysed by fusion XRF with a single point LOI (1000°C). The highly refractory nature of chromite ores requires a specialist approach in the fusion process to ensure that the spinel structure is decomposed and the entire sample is dissolved in the fusion disk. The LOI is usually negative in higher grade ores due to the oxidation of ferrous iron in the spinel structure. The major element analysis can be used to classify the chromite ore.

Chromite Ore XRF Package

Element	Range %	Element	Range %	Element	Range %
Cr ₂ O ₃	0.005 - 100	MgO	0.01 - 100	SO ₃	0.002 - 100
Al ₂ O ₃	0.01 - 100	MnO	0.01 - 100	TiO ₂	0.01 - 100
CaO	0.01 - 100	Na ₂ O	0.01 - 100	V ₂ O ₅	0.005 - 10
Fe ₂ O ₃	0.01 - 100	P ₂ O ₅	0.002 - 100	LOI 1000°C	0.01 - 100
K ₂ O	0.01 - 100	SiO ₂	0.01 - 100		
Li borate fusion / XRF			FB1/XRF35	\$42.00	

Nickel Laterite Ores

The oxidised nature of nickel laterite ore and the low sulphur contents make XRF with a single point LOI an ideal technique for the chemical characterisation of these ores. XRF can accurately quantify the Ni and Co contents of the ore, important trace elements such as Co and Zn, as well as the major oxide components which are used to classify the laterite ore type. Nickel laterite ores can be hygroscopic with high moisture contents. Moisture is therefore corrected for routinely and all results are reported on a dry basis.

Nickel Laterite Ore XRF Package

Element	Range %	Element	Range %	Element	Range %
Ni	0.005 - 20	Fe ₂ O ₃	0.01 - 100	SiO ₂	0.01 - 100
Co	0.005 - 5	K ₂ O	0.01 - 100	SO ₃	0.002 - 100
Al ₂ O ₃	0.01 - 100	MgO	0.01 - 100	TiO ₂	0.01 - 100
CaO	0.01 - 100	MnO	0.01 - 100	Zn	0.005 - 5
Cu	0.005 - 5	Na ₂ O	0.01 - 100	LOI 1000°C	0.01 - 100
Cr ₂ O ₃	0.005 - 10	P ₂ O ₅	0.002 - 100		
Li borate fusion / XRF			FB1/XRF40	\$26.00	

Manganese Ore

XRF, with a single point LOI (1000°C), is routinely used in the accurate quantification of the chemical components of manganese ores. A complete oxide suite is analysed which includes Pb and Ba. These two elements can be important components of the ore and the concentrations of these elements are required to do the requisite matrix corrections in the XRF analysis.

Manganese Ore XRF Package

Element	Range %	Element	Range %	Element	Range %
Mn	0.01 - 100	Fe ₂ O ₃	0.01 - 100	SiO ₂	0.01 - 100
Al ₂ O ₃	0.01 - 100	K ₂ O	0.01 - 100	SO ₃	0.002 - 100
BaO	0.01 - 10	MgO	0.01 - 100	TiO ₂	0.01 - 100
CaO	0.01 - 100	Na ₂ O	0.01 - 100	V ₂ O ₅	0.005 - 10
Cr ₂ O ₃	0.005 - 100	P ₂ O ₅	0.002 - 100	LOI 1000°C	0.01 - 100
Cu	0.005 - 5	Pb	0.005 - 5		
Li borate fusion / XRF			FB1/XRF25	\$33.00	
Zn as an additional element			FB1/XRF25-1	\$35.00	

Legend

Complete recovery for most samples

Near complete recovery for most samples

Not complete recovery

Uranium

Most jurisdictions have regulations that govern the treatment and handling of naturally occurring radioactive materials (NORM). Our laboratories are registered to receive and treat NORM samples and have stringent procedures in place to protect workers and ensure compliance with regulations.

For the accurate low level quantification of uranium and thorium, ICP-MS is the preferred technique. Ore grade uranium samples can be accurately quantified using XRF techniques, taking advantage of the excellent precision and accuracy of fusion XRF.

Uranium Exploration Packages

Uranium Four Acid Exploration ICP-OES & MS Package

Element	Range ppm	Element	Range ppm	Element	Range ppm
U	0.01 - 1%	Fe	100 - 50%	S	50 - 10%
As	0.5 - 1%	K	20 - 10%	Se	0.5 - 1%
Bi	0.01 - 1%	La	0.01 - 5000	Th	0.01 - 5000
Ca	50 - 40%	Mo	0.1 - 1%	V	1 - 2%
Co	0.1 - 2%	Ni	0.5 - 2%		
Cu	0.5 - 2%	Pb	0.5 - 1%		
4 acid digest / ICP-OES & ICP-MS			4A/OM47	\$23.00	

Uranium Ore Grade Packages

Uranium Four Acid Ore Grade ICP-OES & MS Package

Element	Range ppm	Element	Range ppm	Element	Range ppm
U	0.5 - 30%	Fe	100 - 70%	S	100 - 10%
As	10 - 20%	K	200 - 20%	Se	10 - 2%
Bi	0.1 - 10%	La	0.5 - 2%	Th	0.5 - 1%
Ca	100 - 50%	Mo	1 - 10%	V	20 - 5%
Co	10 - 20%	Ni	10 - 70%		
Cu	10 - 70%	Pb	10 - 70%		
U ore grade package 4 acid digest / ICP-OES & ICP-MS			4AH/OM47	\$24.00	

Uranium Nickel Crucible Fusion ICP-MS Package

Element	Range ppm
U	0.1 - 60%
Na peroxide fusion / ICP-MS	
	FP6/MS45
\$18.50	

Additional elements available see page 24.

Uranium Ore Grade XRF Package

Element	Range %
U	0.002 - 10
Li borate fusion / XRF	
	FB1/XRF45
\$33.00	

Legend

Complete recovery for most samples

Near complete recovery for most samples

Not complete recovery

Copper

A spectrum of analytical techniques are offered that add value to the copper industry supply chain. These include ultra-sensitive exploration methods, ore grade characterization and empirical digestion techniques that target copper in different forms. Acid soluble copper refers to the metal content extractable using dilute sulphuric acid. This includes the most common oxide copper species malachite, azurite and chrysocolla. Other copper minerals may also be partially dissolved. Cyanide soluble copper includes most oxide minerals, common sulphide minerals but not chalcopyrite. These techniques are empirical in that the recovery depends on the conditions of the digest, the degree of comminution and the department of the metal in the ore. Total copper is offered by four acid digest. Umpire and commercial exchange assay services are available at Intertek's specialist LSI laboratory, see Minerals Trade Services.

Specialised Copper Methods

Element	Description	Range	Code	Price
Cu	Aqua regia digest / ICP-OES	1 - 1%	Cu-AR1/OE	\$9.00
Cu	4 acid digest / ICP-OES for more complete digestion of complex matrices	1 - 2%	Cu-4A/OE	\$11.00
Cu	Ore grade 4 acid digest / ICP-OES	5 - 70%	Cu-4AO/OE	\$13.50
Cu	Assay for commercial settlement (Intertek LSI)	-		POA
Cu	Multi acid digest / short iodide titration	-	Cu-VOL	\$45.00
Cu Acid Soluble	Acid soluble copper (options available)	Various	Cu-AS/OE	\$9.00
Cu CN Soluble	Cyanide soluble copper (options available)	Various	Cu-CN	\$9.00
Cu Sequential	Acid soluble followed by cyanide soluble copper	Various	Cu-SQ	\$30.00

Lithium

Lithium is a lithophile element that occurs predominantly in silicate minerals where it is diadochic with potassium, sodium, iron and magnesium. Sources of lithium include brines, certain granite pegmatites in the minerals spodumene, petalite and lepidolite and clays, hectorite, in particular. Lithium minerals are easily soluble in 4 acid digests and are also amenable to decomposition using fusion digests. Whereas 4 acid digests may be suitable for simple silicate-hosted lithium assays, lithium minerals in pegmatites may be associated with other important economic minerals such as columbite-tantalite, wolframite and cassiterite which require fusion decomposition to quantify accurately.

Intertek has extensive experience with lithium analysis in pegmatites, alkaline rocks and brine solutions as well as almost all common geological materials including vegetation. For analysis of lithium bearing lithologies that contain significant quantities of Sn, Ta, Nb a fusion digest is recommended to accurately quantify these refractory elements.

48 Element Lithium Exploration Package

Element	Range ppm	Element	Range ppm	Element	Range ppm
Li	0.1 - 5000	Ge	0.1 - 2000	Sb	0.05 - 1%
Ag	0.05 - 500	Hf	0.05 - 2000	Sc	0.1 - 5000
Al	50 - 15%	In	0.01 - 2000	Se	0.5 - 1%
As	0.5 - 1%	K	20 - 10%	Sn	0.1 - 2000
Ba	0.1 - 5000	La	0.01 - 5000	Sr	0.05 - 1%
Be	0.05 - 2000	Mg	20 - 40%	Ta	0.01 - 2000
Bi	0.01 - 1%	Mn	1 - 5%	Te	0.2 - 2000
Ca	50 - 40%	Mo	0.1 - 1%	Th	0.01 - 5000
Cd	0.02 - 2000	Na	20 - 10%	Ti	5 - 2%
Ce	0.01 - 1%	Nb	0.05 - 2000	Tl	0.02 - 2000
Co	0.1 - 2%	Ni	0.5 - 2%	U	0.01 - 1%
Cr	1 - 2%	P	50 - 5%	V	1 - 2%
Cs	0.05 - 2000	Pb	0.5 - 1%	W	0.1 - 2000
Cu	0.5 - 2%	Rb	0.05 - 2000	Y	0.05 - 2000
Fe	100 - 50%	Re	0.002 - 2000	Zn	1 - 2%
Ga	0.05 - 2000	S	500 - 10%	Zr	0.1 - 2000
Lithium 4 acid digestion/ ICP-MS package			4A-Li/MS48	\$27.00	

Zirconium Crucible Fusion ICP-MS Individual Element

Element	Description	Range	Code	Price
Li	Sodium peroxide fusion Zr Crucible	1 - 20%	FP1-Li/MS	\$21.00

Brine Analysis

Description	Code	Price
As, B, Ba, Ca, Co, Cr, Cs, Fe, K, Li, Na, Ni, Mg, Mn, P, Pb, Rb, S, Sc, Se, Sr, Ti, V, Zn	BR-Li01	\$22.50

Detection limits will be dependent on salinity levels. Upper limits may apply for some elements.

Description	Range	Code	Price
Chloride by Colorimetry	5 mg/l	COL03	\$13.50

Brine pH, EC, TDS, SO₄, Total Alkalinity Package

Description	Code	Price
pH, EC, TDS, Sulphate (calculated from S), HCO ₃ , OH, CO ₃ by titration	BR-Li02	\$45.00

Rare Earth Elements

The refractory nature of many of the minerals which host rare earth elements (REE) make fusion followed by ICP-MS an ideal technique for the accurate characterisation of REE ores along with important major, minor and trace components. The fusion approach ensures the complete digestion of all minerals giving total elemental analyses. All data is checked for consistency using chondrite normalised plots.

REE Mineralisation Na Peroxide Fusion ICP-MS Package

Element	Range ppm	Element	Range ppm	Element	Range ppm
La	0.2 - 20%	Ho	0.1 - 2%	Ta	0.1 - 50%
Ce	0.5 - 30%	Er	0.1 - 5%	Hf	0.1 - 5%
Pr	0.1 - 10%	Tm	0.1 - 1%	Zr	5 - 50%
Nd	0.1 - 20%	Yb	0.1 - 5%	Sn	2 - 50%
Sm	0.1 - 10%	Lu	0.1 - 1%	W	1 - 50%
Eu	0.1 - 5%	Y	0.5 - 50%	Li	1 - 20%
Gd	0.1 - 5%	Th	0.1 - 2%	Be	1 - 2%
Tb	0.1 - 2%	U	0.1 - 60%	Ga	1 - 5%
Dy	0.1 - 5%	Nb	10 - 30%		
Sodium peroxide fusion Ni crucible / ICP-MS			FP6/MS33	\$33.00	

REE Mineralisation Li Borate Fusion ICP-MS Package

Element	Range ppm	Element	Range ppm	Element	Range ppm
La	0.2 - 20%	Ho	0.1 - 2%	Nb	0.1 - 5%
Ce	0.5 - 30%	Er	0.1 - 5%	Ta	0.1 - 5%
Pr	0.1 - 10%	Tm	0.1 - 1%	Hf	0.1 - 5%
Nd	0.1 - 20%	Yb	0.1 - 5%	Zr	1 - 50%
Sm	0.1 - 10%	Lu	0.1 - 1%	Sn	1 - 5%
Eu	0.1 - 5%	Y	0.5 - 50%	W	1 - 5%
Gd	0.1 - 5%	Th	0.1 - 2%	Ga	0.5 - 5%
Tb	0.1 - 2%	Be	0.5 - 2%		
Dy	0.1 - 5%	U	0.1 - 20%		
Li borate fusion / ICP-MS			FB6/MS34	\$33.00	

REE XRF Package

Element	Range %	Element	Range %	Element	Range %
La ₂ O ₃	0.01 - 15	Y ₂ O ₃	0.01 - 5	MgO	0.01 - 100
CeO ₂	0.01 - 30	U ₃ O ₈	0.01 - 3	MnO	0.01 - 100
Pr ₆ O ₁₁	0.01 - 5	ThO ₂	0.01 - 3	Na ₂ O	0.01 - 100
Nd ₂ O ₃	0.01 - 10	Al ₂ O ₃	0.01 - 100	P ₂ O ₅	0.005 - 100
Sm ₂ O ₃	0.01 - 5	CaO	0.01 - 100	SiO ₂	0.01 - 100
Eu ₂ O ₃	0.01 - 5	Fe ₂ O ₃	0.01 - 100	SO ₃	0.005 - 5
Gd ₂ O ₃	0.01 - 5	K ₂ O	0.01 - 100	TiO ₂	0.01 - 100
Li borate fusion / XRF			FB1/XRF74	\$45.00	

Legend

Complete recovery for most samples

Near complete recovery for most samples

Not complete recovery

Industrial Minerals

XRF is a very useful technique for the analysis of diverse rock types and is the favored routine method for the full chemical characterisation of assorted industrial mineral feedstocks and products such as attapulgite, kaolinite, pyrophyllite, limestone, dolomite, phosphates, cement, mica and feldspar.

Clays, Limestones & Dolomites

Clay, Limestone & Dolomite XRF Package - suitable for samples containing <500ppm uranium.

Element	Range %	Element	Range %	Element	Range %
Al ₂ O ₃	0.01 - 100	MgO	0.01 - 100	SO ₃	0.002 - 100
CaO	0.01 - 100	MnO	0.01 - 100	TiO ₂	0.01 - 100
Cr ₂ O ₃	0.01 - 100	Na ₂ O	0.01 - 100	LOI 1000°C	0.01 - 100
Fe ₂ O ₃	0.01 - 100	P ₂ O ₅	0.002 - 100		
K ₂ O	0.01 - 100	SiO ₂	0.01 - 100		
Clay minerals package Li borate fusion / XRF			FB1/XRF50	\$26.00	
Limestone & dolomites Li borate fusion / XRF			FB1/XRF60	\$26.00	

Phosphates & Potash

Fusion XRF Packages

Element	Range %	Element	Range %	Element	Range %
Al ₂ O ₃	0.01 - 100	MgO	0.01 - 100	SO ₃	0.002 - 100
CaO	0.01 - 100	MnO	0.01 - 100	TiO ₂	0.01 - 100
Cr ₂ O ₃	0.01 - 10	Na ₂ O	0.01 - 100	LOI 1000°C	0.01 - 100
Fe ₂ O ₃	0.01 - 100	P ₂ O ₅	0.002 - 100		
K ₂ O	0.01 - 100	SiO ₂	0.01 - 100		
Phosphate majors package			FB1/XRF55	\$26.00	
Marine phosphorite and glauconite			FB1/XRF56	\$26.00	

Phosphate Penalty and Beneficial Elements Package

Element	Range ppm	Element	Range ppm	Element	Range ppm
As	0.5 - 1%	Pb	0.5 - 2000	Y	0.05 - 2000
Cd	0.02 - 500	Sm	0.01 - 5000	Yb	0.01 - 2000
Ce	0.01 - 5000	Th	0.01 - 5000		
La	0.01 - 5000	U	0.01 - 1%		
4 acid digest / ICP-MS			4A/MS55	\$21.00	

Additional Elements

Element	Description	DL	Code	Price
Hg	Controlled temperature acid digest / ICP-MS	0.2ppm	HG1/MS	\$9.75
F	Carbonate fusion / SIE	50ppm	FC7/SIE	\$27.00

Complete Phosphate Package

Element	Description	Code	Price
Majors: Al ₂ O ₃ , CaO, Cr ₂ O ₃ , Fe ₂ O ₃ , K ₂ O, MgO, MnO, Na ₂ O, P ₂ O ₅ , SiO ₂ , SO ₃ , TiO ₂ , LOI	Li borate fusion / XRF	P/201	\$75.00
Penalty & beneficials: As, Cd, Ce, La, Pb, Sm, Th, U, Y, Yb	4 acid digest / ICP-MS		
Hg	Controlled temperature digest / ICP-MS		
F	Carbonate fusion / selective ion electrode		

Refractory Minerals

Fusion techniques ensure the total dissolution of almost all minerals and thus facilitate the accurate XRF analysis of elements that are hosted in refractory mineral species. Detection limits may be higher than the equivalent acid digestions however the decomposition is ensured. This is particularly important with elements that are hosted in very refractory minerals that may not decompose in four acid digests such as rutile, ilmenite, zircon, certain garnet species, some spinels, columbite-tantalite, cassiterite and wolframite.

Cassiterite XRF Package

Element	Range %	Element	Range %	Element	Range %
SnO ₂	0.01 - 40	K ₂ O	0.01 - 100	SiO ₂	0.01 - 100
WO ₃	0.01 - 10	MgO	0.01 - 100	SO ₃	0.005 - 5
Al ₂ O ₃	0.01 - 100	MnO	0.01 - 100	TiO ₂	0.01 - 100
CaO	0.01 - 100	Na ₂ O	0.01 - 100	LOI 1000°C	0.01 - 100
Fe ₂ O ₃	0.01 - 100	P ₂ O ₅	0.005 - 100		
Cassiterite Package Li borate fusion / XRF			FB1/XRF70	\$37.00	

Mineral Sand – Zircon XRF Package

Element	Range %	Element	Range %	Element	Range %
ZrO ₂	0.01 - 70	K ₂ O	0.01 - 100	SiO ₂	0.01 - 100
HfO ₂	0.005 - 2	MgO	0.01 - 100	SO ₃	0.002 - 5
Al ₂ O ₃	0.01 - 100	MnO	0.01 - 100	TiO ₂	0.01 - 100
CaO	0.01 - 100	Na ₂ O	0.01 - 100	V ₂ O ₅	0.005 - 5
Fe ₂ O ₃	0.01 - 100	P ₂ O ₅	0.002 - 100	LOI 1000°C	0.01 - 100
Mineral Sand – Zircon Package Li borate fusion / XRF			FB1/XRF71	\$37.00	

Mineral Sand – Rutile XRF Package

Element	Range %	Element	Range %	Element	Range %
TiO ₂	0.01 - 100	K ₂ O	0.01 - 100	SO ₃	0.002 - 5
V ₂ O ₅	0.005 - 5	MgO	0.01 - 100	ZrO ₂	0.005 - 5
Al ₂ O ₃	0.01 - 100	MnO	0.01 - 100	TiO ₂	0.01 - 100
CaO	0.01 - 100	Na ₂ O	0.01 - 100	LOI 1000°C	0.01 - 100
Cr ₂ O ₃	0.005 - 5	P ₂ O ₅	0.002 - 100		
Fe ₂ O ₃	0.01 - 100	SiO ₂	0.01 - 100		
Mineral Sand – Rutile Package Li borate fusion / XRF			FB1/XRF72	\$37.00	

Tantalites XRF Package

Element	Range %	Element	Range %	Element	Range %
Ta ₂ O ₅	0.01 - 45	Fe ₂ O ₃	0.01 - 100	SiO ₂	0.01 - 100
Nb ₂ O ₅	0.01 - 25	K ₂ O	0.01 - 100	SO ₃	0.005 - 5
SnO ₂	0.01 - 10	MgO	0.01 - 100	TiO ₂	0.01 - 100
WO ₃	0.01 - 10	MnO	0.01 - 100	LOI 1000°C	0.01 - 100
Al ₂ O ₃	0.01 - 100	Na ₂ O	0.01 - 100		
CaO	0.01 - 100	P ₂ O ₅	0.005 - 100		
Tantalites Package Li borate fusion / XRF			FB1/XRF73	\$41.00	

Tungsten Ores XRF Package

Element	Range %	Element	Range %	Element	Range %
WO ₃	0.01 - 80	K ₂ O	0.01 - 100	SiO ₂	0.001 - 100
MoO ₃	0.01 - 5	MgO	0.01 - 100	SO ₃	0.005 - 5
Al ₂ O ₃	0.01 - 100	MnO	0.01 - 100	TiO ₂	0.01 - 100
CaO	0.01 - 100	Na ₂ O	0.01 - 100	LOI 1000°C	0.01 - 100
Fe ₂ O ₃	0.01 - 100	P ₂ O ₅	0.005 - 100		
Tungsten Ore Package Li borate fusion / XRF			FB1/XRF75	\$41.00	

Legend

Complete recovery for most samples

Near complete recovery for most samples

Not complete recovery

Litho geochemistry & Whole Rock Analyses

Litho geochemistry

Litho geochemical analyses involve the comprehensive chemical characterization of geological samples. Many geological applications require the accurate analysis of both mobile and immobile elements that can assist in identifying precursor rock types and quantification of any geological processes that may have affected them. Litho geochemical techniques are also useful for geochemical fingerprinting, quantification of crystal fractionation, identifying regolith processes and for stratigraphic correlation. Several analytical techniques are used including both fusion and four acid digests with XRF, ICP-OES and ICP-MS finishes. These methods produce data of highest quality that is suitable for exploration, research, publication and geochemical modeling.

Lithium borate fusion offers an aggressive digestion that dissolves almost all minerals while limiting losses due to volatilisation. This technique is optimised for a wide range of element concentrations. Major element analysis can be carried out by either ICP-OES or XRF finishes. XRF is the more precise option, however, mineralised samples may be more amenable to an ICP finish. Sample matrices exceeding sulphide sulphur (2%) or copper (1%) are not suitable by this method.

General characterisation packages are listed for convenient and cost effective selection. Customised packages are available on request to ensure selection of the best analytical options for your application. Please contact our technical staff for an individual consultation.

Litho geochemical characterisation package suitable for classification, geochemical modeling and alteration studies.

Element	Description	Code	Price
Whole rock: SiO ₂ , TiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ , MnO, MgO, CaO, Na ₂ O, K ₂ O, P ₂ O ₅ , Ba, Cr, S, LOI	Lithium borate fusion ICP-OES & ICP-MS	LITH/203	\$60.00
REE: La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu			
HFSE: Hf, Nb, Th, Ta, Y, Zr			
Trace elements: Ba, Cr, Cs, Ga, Rb, Sc, Sn, Sr, U, V, W			

Comprehensive litho geochemical characterisation package suitable for a wide range of geochemical applications where a full range of major and trace elements, including chalcophile elements are required.

Element	Description	Code	Price
Whole rock: SiO ₂ , TiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ , MnO, MgO, CaO, Na ₂ O, K ₂ O, P ₂ O ₅ , BaO, Cr ₂ O ₃ , SO ₃ , LOI	Lithium borate fusion XRF (or ICP-OES)	LITH/204X (LITH/204OE)	\$102.00 (\$93.00)
REE: La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu	Lithium borate fusion ICP-OES / ICP-MS		
HFSE: Hf, Nb, Th, Ta, Y, Zr			
Trace elements: Ba, Cr, Cs, Ga, Rb, Sc, Sn, Sr, U, V, W			
Ag, As, Be, Bi, Cd, Co, Cu, Ge, In, Li, Mo, Ni, Pb, Re, Sb, Se, Te, Tl, Zn	4 acid digestion ICP-MS	LITH/205X (LITH/205OE)	\$116.00 (\$108.00)
C, S	CS Analyser		
Au, Pt, Pd as additional elements	Fire Assay/ ICP-MS		
Hg, F, FeO are available as optional analytes to this package			POA

Whole Rock Analysis

Determination of major element oxides by fusion/ ICP-OES or XRF coupled with loss on ignition (LOI) by thermo gravimetric analysis (TGA) offer whole rock composition in non-mineralised samples. Further specific commodity packages are available under the Ores and Commodities section.

Whole Rock Fusion XRF Package

Element	Range %	Element	Range %	Element	Range %
SiO ₂	0.01 - 100	MgO	0.01 - 100	BaO	0.01 - 5
TiO ₂	0.01 - 100	CaO	0.01 - 100	Cr ₂ O ₃	0.01 - 10
Al ₂ O ₃	0.01 - 100	Na ₂ O	0.01 - 100	SO ₃	0.01 - 100
Fe ₂ O ₃	0.01 - 100	K ₂ O	0.01 - 100	LOI 1000°C	0.01 - 100
MnO	0.01 - 100	P ₂ O ₅	0.002 - 100		
Whole rock		Li borate fusion / XRF		FB1/XRF20	\$30.00

Whole Rock Fusion ICP-OES Package

Element	Range %	Element	Range %	Element	Range %
SiO ₂	0.01 - 100	MgO	0.01 - 100	Ba	0.005 - 5
TiO ₂	0.01 - 100	CaO	0.01 - 100	Cr	0.002 - 5
Al ₂ O ₃	0.01 - 100	Na ₂ O	0.01 - 100	S	0.01 - 30
Fe ₂ O ₃	0.01 - 100	K ₂ O	0.01 - 100	LOI 1000°C	0.01 - 100
MnO	0.01 - 100	P ₂ O ₅	0.01 - 100		
Whole rock		Li borate fusion / ICP-OES		FB6/OE01	\$30.00

Rare Earth Element (REE) Fusion ICP-MS Package

Element	Range ppm	Element	Range ppm	Element	Range ppm
La	0.2 - 20%	Eu	0.1 - 5%	Er	0.1 - 5%
Ce	0.5 - 30%	Gd	0.1 - 5%	Tm	0.1 - 1%
Pr	0.1 - 10%	Tb	0.1 - 2%	Yb	0.1 - 5%
Nd	0.1 - 20%	Dy	0.1 - 5%	Lu	0.1 - 1%
Sm	0.1 - 10%	Ho	0.1 - 2%		
REE		Li borate fusion / ICP-MS		FB6/MS61	\$26.00
REE add on		ICP-MS package as add ons			POA

High Field Strength Element (HFSE) Fusion ICP-MS Package

Element	Range ppm	Element	Range ppm	Element	Range ppm
Hf	0.1 - 5%	Ta	0.1 - 5%	Y	0.5 - 50%
Nb	0.1 - 5%	Th	0.1 - 2%	Zr	1 - 50%
HFSE		Li borate fusion / ICP-M		FB6/MS63	\$20.00
HFSE add on		ICP-MS package as add ons			POA

Minor & Trace Element Fusion ICP-OES & ICP-MS Package

Element	Range ppm	Element	Range ppm	Element	Range ppm
Ba	0.5 - 5%	Rb	0.1 - 5%	U	0.1 - 30%
Cr	20 - 5%	Sc	10 - 5%	V	10 - 5%
Cs	0.1 - 1%	Sn	1 - 5%	W	1 - 5%
Ga	0.1 - 1%	Sr	0.2 - 20%		
Minor & trace		Li borate fusion / ICP-OES & ICP-MS		FB6/OM65	\$31.50
Minor & trace add on		ICP-OES & ICP-MS package as add ons			POA

Base Metals and Trace Elements Four Acid ICP-MS Package

Element	Range ppm	Element	Range ppm	Element	Range ppm
Ag	0.05 - 500	Ge	0.1 - 2000	Sb	0.05 - 1%
As	0.5 - 1%	In	0.01 - 2000	Se	0.5 - 1%
Be	0.05 - 2000	Li	0.1 - 5000	Te	0.2 - 2000
Bi	0.01 - 1%	Mo	0.1 - 1%	Tl	0.02 - 2000
Cd	0.02 - 2000	Ni	0.5 - 2%	Zn	1 - 2%
Co	0.1 - 2%	Pb	0.5 - 1%		
Cu	0.5 - 2%	Re	0.002 - 2000		
Base metals & trace		4 acid digest / ICP-MS		4A/MS68	\$19.50

Additional Analysis

Carbon and Sulphur Analysis

Element	Description	Detection Limit	Code	Price
C,S	Total carbon & sulphur by CS analyser	0.01%- 40%	CSA03	\$18.00

Platinum Group Elements by Fire Assay ICP-MS

Element	Description	Detection Limit	Code	Price
Au, Pt, Pd	Fire assay / ICP MS	1ppb	FA25/MS	\$15.50
Au, Pt, Pd, Ir, Os, Rh, Ru	NiS fire assay / ICP-MS	1ppb (Au 2ppb)	NS25/MS	\$70.00

Mercury Analysis by Cold Vapour AAS

Element	Description	Detection Limit	Code	Price
Hg	Specialised acid digest / cold vapour AAS	1ppb	AR1/CV	\$11.25

Fluoride Analysis by Selective Ion Electrode

Element	Description	Detection Limit	Code	Price
F	Carbonate fusion / SIE	50ppm	FC7/SIE	\$27.00

Ferrous Iron

Element	Description	Detection Limit	Code	Price
FeO	Acid digestion / titration	0.1%	AD71/VOL	\$37.50

Chloride

Element	Description	Detection Limit	Code	Price
Cl	Carbonate leach / colorimetry	0.2%	Cl1/COL	\$27.40

Legend

Complete recovery for most samples

Near complete recovery for most samples

Not complete recovery

Individual Methods

Element	Description	Detection Limit	Code	Price
Ba, Sr	Fusion / ICP-OES first element	20ppm	FP7/OE	\$20.25
	Additional element			\$0.75
Barium in barite	EDTA extraction / ICP-OES	2ppm	EDTA/OE	\$12.40
Cl	Carbonate leach / colorimetry	0.02%	CL1/COL	\$27.40
F	Carbonate fusion / SIE	50ppm	FC7/SIE	\$27.40
Hg	Acid digest / cold vapour AAS	1ppb	AR01/CV	\$11.25
Hg	Acid digest / ICP-MS	0.2ppm	HG1/MS	\$9.75
Hg*	Acid digest / cold vapour AAS	0.01ppb	HG2/CV	\$15.00
Se	Precipitation/ ICP-MS	0.01ppm	SE1/MS	\$24.00
FeO	Acid digestion / titration	0.1%	AD71/VOL	\$37.50

*suitable for sample containing organic material

Gravimetric Determinations

Element	Description	Detection Limit	Code	Price
LOD	Loss on drying (105°C or client nominated temperature)	0.01%	LOD/GR	\$7.50
LOI	Loss on ignition (1000°C or client nominated temperatures)	0.01%	LOI/GR	\$7.50
	Multiple temperatures each additional			\$2.00
SG	*Specific gravity / core and rocks uncoated		SG/GR	\$11.25
SG	* Specific gravity / core and rocks wax coated		SGW/GR	\$26.25
SG	*Specific gravity / core and rocks lacquer coated		SGC/GR	\$26.25
SG	*Specific gravity / metallurgy core and rocks wax coated		SGWM/GR	\$26.25
SG	Pulp density (gas pycnometer method)		SGP/PYC	\$6.50
SG	Liquid specific gravity		SGL/GR	\$15.00

*Not suitable for highly friable samples such as unconsolidated sediments

Carbon and Sulphur Analysis

Carbon and sulphur analyses using a variety of spectroscopic or gravimetric methods with the option of pretreatments for targeting specific forms of the analyte element.

Element	Description	Detection Limit	Code	Price
C	Total carbon by CS analyser	0.01% - 50%	CSA01	\$12.00
S	Total sulphur by CS analyser	0.01% - 50%	CSA02	\$12.00
C,S	Total carbon & sulphur by CS analyser	0.01% - 50%	CSA03	\$18.00
C non carbonate	Weak acid digestion / CS analyser 0.01%	0.01% - 50%	C71/CSA	\$26.25
C carbonate	Acetic acid digestion / CS analyser 0.01%	0.01% - 50%	C72/CSA	\$26.25
C graphitic	Weak acid digestion, 420°C roast / CS analyser	0.1% - 40%	C73/CSA	\$30.00
S-SO4*	HCl digest for soluble sulphates / ICP-OES	0.01% - 50%	S71/OE	\$15.00
S-SO4*	Carbonate extract for soluble sulphate /gravimetric	0.01% - 50%	S72/GR	\$34.50

*May not include all Ba, Sr and Pb sulphates

Acid Rock Drainage Package

A range of tests to support prediction of acid generation of mine waste. Individual tests are available on request.

Element	Description	Detection Limit	Code	Price
ANC	Titrimetric measurement of acid consumption	1kgH2SO4/t	ARD01	\$63.00
NAG	Titrimetric measurement of acid generation by oxidation	1kgH2SO4/t		
NAG pH	pH of oxidised solution	0.1		
C,S	Total carbon & sulphur by CS analyser	0.01% - 50%		
pH	pH of 1:5 water extract	0.1		
EC	Conductivity of 1:5 water extract			
NAPP	Net acid producing potential calculated from ANC and S	1kgH2SO4/t		
MPA	Maximum potential acidity calculated from S	1kgH2SO4/t		

Specialised Services

Mineralogy

Applied mineralogy is the study of the mineral phases of materials which contrasts with and complements a traditional chemical analysis. Applied mineralogy identifies the nature of the mineral phase, the grain size and morphology, textures, mineral associations and other parameters. Applied mineralogy has important applications in mineral exploration, mineral processing, mineral waste disposal and treatment, hydrometallurgy, pyrometallurgy and refining. It is also utilised in the oil and gas, coal and environmental industries.

Various ores and commodities can be analysed such as base metal ores, precious metal ores, iron ores, bauxite, chromite, nickel, uranium, rare earths, industrial minerals (including graphite), refractory minerals and clays.

A comprehensive suite of applied mineralogy analyses are available. Please call our Perth laboratory to discuss the options best suited to your requirements with Intertek's XRD specialist.

Bulk Mineralogy

X-Ray Diffraction

Powder X-ray diffraction (XRD) is an analytical technique primarily employed for the identification and quantification of crystalline materials in bulk samples, both natural and synthetic.

The results given are either qualitative (descriptive of the sample make-up) or quantitative. Quantitative results can include the non-crystalline (amorphous) content of the sample

Sample Preparation

XRD Crush and Pulverize Package

Description	Code	Price
Crush -2mm, rotary split 800g, pulverise 800g to < 60um	XRD13	\$11.25

*Samples are not to be dried

XRD Micronizing Package

Description	Code	Price
Micronizing	XRD14	\$11.25

*Samples are not to be dried

XRD Crush, Pulverize and Micronize Package

Description	Code	Price
Crush -2mm, rotary split 800g, pulverise 800g to <60um, micronize	XRD15	\$18.75

*Samples are not to be dried

XRD Crush, Pulverize and Micronize Package

Description	Code	Price
Pulverise <800g to < 60um, micronize	XRD16	\$15.00

X-Ray Diffraction Analysis

A number of qualitative and quantitative options are available. Please contact the laboratory to discuss your specific requirements.

Element	Description	Code	Price
QUALITATIVE	Qualitative analysis for complete mineralogy	XRDQual	\$71.00
QUANTITATIVE	Quantitative analysis for complete mineralogy (crystalline content only)	XRDQuant	\$97.00
QUANTITATIVE	Quantitative analysis for complete mineralogy and amorphous content	XRDQuant01	\$112.00
QUANTITATIVE	Quantitative analysis for complete mineralogy and amorphous content (2 x Scan analysis)	XRDQuant02	\$165.00

Clay Mineralogy

Clays are important constituents of soils, mudstones, shales and some ores that often require specialist attention. A range of analytical tests are available, including:

- Clay separation from bulk materials
- Qualitative or quantitative XRD analysis from the bulk sample
- Clay mineral identification (XRD) (from glycolation and heating regimes)
- High resolution microscopy analysis via SEM-EDS/QEMSCAN
- Swelling Index of clays in water (adapted from the ASTM method)
- Swelling Index of clays in solutions of specific interest
- Cation Exchange Capacity (CEC) analysis

XRD Clay separation

Description	Code	Price
Separation of clay fraction, <2 µm	CLAYF	\$50.00
Separation of clay fraction, <2 µm, in iron-rich samples	CLAYFFe	\$85.00

X-Ray Diffraction Analysis

Element	Description	Code	Price
QUALITATIVE	Qualitative analysis of clays (incl. glycolation and heating)	XRDQual01	\$200.00

ASD Terraspec Scan

The TerraSpec 4 Hi Res spectrometer offers a rapid scan for the identification and characterisation of minerals visible in the NIR range. Minerals and mineral groups include haematite, goethite, garnet, pyroxene, amphibole, epidote, apatite, tourmaline, topaz, clay, mica, chlorite, serpentine, carbonates, hydrous silicates and rare earth minerals. The scan information can be used to identify, characterise and map alteration zones associated with various ore forming processes.

For best results, it is recommended that the characterisation of the mineral analysis be confirmed by XRD analysis on either a continuum or a selected subset of samples.

Description	Code	Price
TerraSpec 4 Hi Res scan	/NIR	POA
TSG Post processing mineralogy report - standard report	/NIR01	POA

Micro Mineralogy

QEMSCAN

Automated mineralogy via QEMSCAN (Quantitative Evaluation of Minerals by Scanning Electron Microscopy) is used to identify mineral phases, in situ, at the micron scale on polished blocks or thin sections.

As well as identifying the minerals present, the processing of the data allows the visualization of the textural and spatial arrangements of the minerals. The processing can thus determine grain sizes and shapes as well as provide information for mineral associations, mineral liberation, elemental deportment and elemental mapping.

The technique is best used in conjunction with the bulk mineralogical data obtained from XRD. Please contact us for options.

Minerals Trade Services

Intertek Minerals Trade Services provide independent inspection, sampling, testing and certification services which assist to protect the quantity and quality of mineral commodities to reduce commercial risk in the trading environment. Inspection and testing services are completed to appropriate international standards and procedures.

Non ferrous commercial exchange assay services are provided by Intertek's industry recognised Laboratory Services International (LSI), based in Rotterdam, Netherlands. LSI is an established umpire laboratory providing analytical services to miners, traders and refiners with a long history of expertise in non-ferrous party and umpire analysis and is an industry leader for accuracy, service quality and independence.

In addition, Intertek provides dedicated onsite laboratory services for grade control, process control and shipment samples for iron ore, gold and base metal operations. Iron ore testing facilities are ISO/IEC 17025 accredited for analysis iron ore as per the ISO-9516 Standard.

The global Intertek Minerals Inspection Team also performs risk management and inspection services in load and discharge ports alike, offering a full scope of WSMD and party assays, in locations from the Americas, Africa to China and the Far East.

Cargo Inspection Services include:

- Marine cargo surveying
- Loading & discharge superintendence
- Independent ship/cargo damage & repair surveys
- Pre shipment inspection
- Government statutory surveys
- Witness & audit
- Marine consultancy
- Stockpile measurement
- Safety and certification services
- Independent draft surveys
- On hire/off hire/draft/bulk surveys
- Ship vetting services
- P & I surveys
- Foreign trade standards
- Metering & tank calibration
- Loss control
- Marine training

Intertek's global independent sampling, inspection and certification services help protect the quantity and quality of commodities and reduce commercial risk. Please contact us to see how Intertek can help your organisation with Minerals Trade Services.

Mine and Port Site Laboratories

Through its dedicated Mine Site Services project team, Intertek is able to provide its clients with a complete solution for any scale of mine or port site laboratory installation, from concept phase to commissioning and contract management. Intertek operates, designs and commissions dedicated mine site laboratories in remote locations to enhance its service to mining operations across multiple mineral commodities.

Intertek's automated and robotic sample systems are purpose built, ranging from individual cells to fully integrated systems providing complete end-to-end sampling to analysis solutions. Intertek Robotic Laboratories (IRL) offers unmatched experience and expertise in the operation of fully automated laboratories in remote locations and is the largest commercial operator of fully automated laboratories.

Outsourcing of a mine-site laboratory offers the benefit of Intertek's world-class expertise and services and enables companies to focus resources and capital on their core business.

Mine-Site Laboratory Services:

- Sample preparation
- Mineral assay services
- Robotics and automated laboratory systems
- Laboratory outsourcing (build, supply, operate options)
- Consulting services e.g. Laboratory design, laboratory audits, round robins
- Ongoing staffing and technical support

Minerals Processing

Supported by Intertek Minerals global laboratory network Intertek offers mineral processing and mineralogical testing services to the mining industry for all major ore types. Sample preparation facilities are licensed radiation premises and equipped to handle hazardous materials.

Intertek Mineral Processing offers tailored programs to the needs of individual projects, from bench scale to small scale pilot plant studies. Services include:

- Ore characterisation
- Flotation
- Magnetic separation
- Batch leaching testwork
- Comminution
- Knelson concentration

Minerals Environmental Testing Services

Intertek environmental laboratories support the minerals industry with water, soil and air testing to governmental, regulatory and industry standards.

Minerals environmental services include:

- Water quality
- Ecotoxicology services
- Biological tissue analysis
- Ambient air quality
- Acid sulphate soils
- Environmental baseline studies
- Waste analysis and characterisation
- Sediment and soil analysis
- Soil nutrient analysis
- Air emissions testing
- Acid rock drainage prediction test
- Field sampling and on-site testing

Exploration and Production Services

From reservoir services and production support, Intertek's analytical and scientific services are focused on extending the longevity of plant and equipment, reducing environmental impacts and optimising operations.

Services include:

- Petroleum geochemistry
- Petrophysics/core analysis
- Environmental chemistry
- Ecotoxicology
- Industrial chemistry

Business Assurance

Management systems auditing helps you find and implement best practices for continual improvement, and adds strategic value to your business.

Intertek's comprehensive auditing and certification services provide the tools you need to evaluate and continually improve your business processes.

As an accredited third party registrar, we provide independent verification to ensure that your management system is effective in achieving your business objectives, while also certifying that it meets internationally recognised standards including ISO 9001, ISO 14001 and OHSAS 18001.

Our internal audit, second party supplier audit, and process analysis services will help you proactively monitor performance while saving valuable time and money.

Our services include:

Management Systems Certification:

- ISO 9001
- ISO 14001
- OHSAS 18001 / AS/NZS 4801

Supply Chain Assessment & Compliance Programs:

- Workplace Conditions Assessment (WCA)
- Supplier Qualification Programs (SQP)
- Global Security Verification (GSV)

Environmental & Sustainability Auditing & Certification:

- QC 080000

Industry Services

Intertek's Industry Services support the mining, oil and gas, power, construction, engineering, chemical and other heavy industries to manage operational risk and maximise returns. Applying leading inspection, testing, verification and monitoring practices, we assist clients to effectively manage product and process development, regulatory compliance, supply chain integrity and plant and asset maintenance. We enhance our customers' returns from production and manufacturing whilst improving safety, reliability and uptime.

Services include:

- Technical Staffing Services (TSS)
- Technical Inspection Services (TIS)
- Intertek Surveying Services (ISS)
- Asset Integrity Management (AIM)
- Non-Destructive Testing (NDT)

General Information

Sample Despatch

To assist with the efficient processing of your samples please email all assay instructions and any freight information prior to or at the time of despatch. Sample submissions received without written instructions cannot be processed until adequate written instructions are received from the client.

All discrepancies between submission sheets and actual samples received will be reported prior to commencement of the processing.

We recommend that all submissions of samples are clearly labelled and packaged in a concise and systematic order and are accompanied by accurate and detailed paperwork. To facilitate safe manual handling we would appreciate that samples be packaged in units not exceeding 25kg each. Sample submissions poorly labelled or packaged may incur additional sorting charges. Please “flag” the bag containing the paperwork.

Sample submission pads and pre-addressed stick-on labels are available upon request free of charge. A sample submission form is available from our web site. We offer an online submission service or the option to print a submission to be either emailed or faxed.

The minimum information required on any sample submission sheet is:

1. Client name
2. List or range of sample numbers
3. Sample preparation required
4. Elements required for analysis
5. Methods of analysis preferred
6. Result destination(s)
7. Electronic data format
8. Invoice destination
9. Sample storage requirements
10. Appropriate warnings if any samples are potentially hazardous (Refer to page 8)
11. Indication of any samples that may cause problems during the preparation or analysis. This includes the presence of normally trace elements at percent levels, visible gold, graphitic shales, etc.

Certain samples may require classification as dangerous goods, for the purpose of transport, processing and storage. Compliance is the client's responsibility, please ensure that the samples have been classified, marked and transported in accordance with the requirements of dangerous goods legislation.

Your co-operation with sample submissions will eliminate unnecessary delays in turnaround.

Importation of Samples into Australia

Intertek Genalysis laboratories in Perth and Townsville are Australian Quarantine Inspection Service (AQIS) quarantine approved premises for the clearance, reception and treatment of samples from overseas.

When importing mineral samples into Australia from International sources the following document requirements should be followed:-

- Importation of samples that have been obtained from a depth greater than two meters and are clean and free of surface and plant related material can be imported into Australia without requiring quarantine treatment. To comply, goods must be accompanied by a manufacturers declaration.
- Importation of all material obtained from the first two meters of the earth surface (surface material), is required to be quarantine heat treated to a core temperature of 160°C for a minimum of two hours. Goods must be accompanied by a manufacturers declaration and by a “Permit to Import Quarantine Material”.
- Importation of water samples is available at some locations and requires prior notice. Please contact NTEL for further information.

Detailed information and document requirements on how to successfully import mineral samples into Australia can be obtained through our website or by contacting the Perth Office.

A nominal fee is charged for quarantine treatment. Other expenses related to the importation will be charged at cost.

Service Fees and Surcharges

Prices in this schedule are effective from 1st January 2016.

Intertek Genalysis does not charge an administration or batch fee, however there is a minimum invoice charge of \$200.00 for routine geochemistry and \$250.00 for all other work.

All prices in this brochure are calculated on the basis of multiple sample batches rather than individual samples; consequently single sample jobs will be invoiced at triple rates and submissions of two samples will carry a 50% surcharge.

When sample submissions include largely disparate sample matrices and/or differing analytical requirements, they may be treated as separate submissions and multiple jobs may be generated for each discrete grouping, each possibly attracting minimum job fees or small batch size surcharges.

A 50% surcharge is added to invoices where a SANAS/NATA endorsed report is requested. Such a request must be made prior to, or at the time of, submitting the samples.

All non account work requires payment up front prior to commencement of work. Alternatively, please contact Business Development for account establishment.

Discounts may apply for large batches – please contact us to discuss your needs.

All prices quoted in this schedule are in US dollars, and exclude Value Added Taxation, Goods and Services Taxes and/or Withholding Taxes as may be applicable.

Quality Assurance

Regular participation in international, national and internal proficiency testing programs and client specific proficiency programs complements NATA ISO/IEC 17025 accreditation ensuring international standards are maintained in the laboratories' procedures, methodology, validation, QA/QC and data handling.

Certified Reference Materials and/or in house controls, blanks and replicates are analysed with each batch of samples. These quality control results are reported along with the sample values in the final report. Selected samples are also re-analysed to confirm anomalous results. Prices include the reporting of all QC data except where more than 10% repeats are considered necessary in cases such as poor reproducibility due to particulate precious metals, in which case additional repeats may be charged for.

Where the concentration of an element exceeds the capacity of the original method selected, re-analysis will be carried out using a more appropriate technique at the client's expense, unless otherwise requested.

Ethics and Compliance

Intertek is committed to maintaining the total confidence of its customers and shareholders. One of the Group's primary business objectives is to ensure both compliance with local, national and international laws and the accuracy and validity of reports and certificates that it provides to customers.

The foundations of the policy rest with the Group's employees, each of whom must comply with the company's Code of Ethics and Zero Tolerance policies outlining the high standards expected of them in all business dealings.

Our compliance aims:

- To avoid conflicts of interest and to act openly, responsibly and within the confines of the law and internationally accepted guidelines.
- To implement current 'best practice' policies in all control procedures.
- To maintain a culture in which all employees know what is expected of them.
- To monitor adherence to organisational controls and reporting procedures.
- Compliance is a core component of Intertek's business strategy to ensure high standards of professional conduct and ensure ethical behaviour and integrity of services.

Conversion Tables

Useful Chemical Conversion Factors

Element	Factor	Compound	Element	Factor	Compound	Element	Factor	Compound			
Al	x	1.889	Al ₂ O ₃	Fe	x	1.43	Fe ₂ O ₃	Pb	x	1.155	PbS
As	x	1.32	As ₂ O ₃	Fe	x	1.574	FeS	Rb	x	1.094	Rb ₂ O
B	x	3.22	B ₂ O ₃	K	x	1.205	K ₂ O	Sb	x	1.197	Sb ₂ O ₃
Ba	x	1.699	BaSO ₄	La	x	1.173	La ₂ O ₃	Si	x	2.139	SiO ₂
Ba	x	1.117	BaO	Li	x	2.153	Li ₂ O	Sn	x	1.27	SnO ₂
Be	x	2.775	BeO	Mg	x	1.658	MgO	Sr	x	1.183	SrO
Ca	x	1.399	CaO	Mg	x	3.648	MgCO ₃	Ta	x	1.221	Ta ₂ O ₅
Ca	x	2.497	CaCO ₃	Mn	x	1.291	MnO	Th	x	1.138	ThO ₂
Ce	x	1.171	Ce ₂ O ₃	Mn	x	1.582	MnO ₂	Ti	x	1.668	TiO ₂
Co	x	1.271	CoO	Mo	x	1.5	MoO ₃	U	x	1.179	U ₃ O ₈
Cr	x	1.462	Cr ₂ O ₃	Mo	x	1.668	MoS ₂	V	x	1.785	V ₂ O ₅
Cs	x	1.06	Cs ₂ O	Na	x	1.348	Na ₂ O	W	x	1.261	WO ₃
Cu	x	1.252	CuO	Nb	x	1.432	Nb ₂ O ₅	Y	x	1.27	Y ₂ O ₃
Cu	x	1.252	Cu ₂ S	Ni	x	1.273	NiO	Zn	x	1.245	ZnO
F	x	2.055	CaF ₂	P	x	2.291	P ₂ O ₅	Zn	x	1.49	ZnS
Fe	x	1.287	FeO	Pb	x	1.077	PbO	Zr	x	1.351	ZrO ₂

Common Equivalents

ppm	ppb	%	grams / metric tonne
1	1,000	0.0001	1
10	10,000	0.001	10
100	100,000	0.01	100
1,000	1,000,000	0.1	1,000
10,000	10,000,000	1	10,000

Drill Core Specifications

Drill Core	Diameter (mm)	Volume per meter (cm ³)		
		Full	Half	Quarter
TT	35.0	960	480	240
BQ	36.4	1040	520	260
NQ	47.6	1780	890	445
HQ	63.5	3170	1585	793
BQ3	33.5	880	440	220
NQ3	45.1	1600	800	400
HQ3	61.1	2930	1465	733

Mass (g) = Volume/meter x SG x length (m)

Recommended Methods of Analysis for Low Grade Geological Materials



Element Name	Atomic Number	Atomic Weight	Primary Method	Secondary Method	Other Method
Hydrogen	1	1.0079			
Lithium	3	6.941			
Beryllium	4	9.0122			
Sodium	11	22.990			
Magnesium	12	24.305			
Potassium	19	39.098			
Calcium	20	40.078			
Scandium	21	44.956			
Titanium	22	47.867			
Vanadium	23	50.942			
Chromium	24	51.996			
Manganese	25	54.938			
Iron	26	55.845			
Cobalt	27	58.933			
Nickel	28	58.693			
Copper	29	63.546			
Zinc	30	65.38			
Gallium	31	69.723			
Germanium	32	72.64			
Arsenic	33	74.922			
Selenium	34	78.96			
Bromine	35	79.904			
Krypton	36	83.798			
Rubidium	37	85.468			
Strontium	38	87.62			
Barium	56	137.33			
Cesium	55	132.91			
Lanthanum	57	138.91			
Yttrium	39	88.906			
Zirconium	40	91.224			
Niobium	41	92.906			
Molybdenum	42	95.96			
Technetium	43	98			
Ruthenium	44	101.07			
Rhodium	45	102.91			
Palladium	46	106.42			
Silver	47	107.87			
Cadmium	48	112.41			
Indium	49	114.82			
Tin	50	118.71			
Antimony	51	121.76			
Tellurium	52	127.60			
Iodine	53	126.90			
Xenon	54	131.29			
Francium	87	223			
Radium	88	226			
Actinium	89	227			
Rutherfordium	104	261			
Dubnium	105	262			
Seaborgium	106	266			
Bohrium	107	264			
Hassium	108	277			
Meitnerium	109	268			
Darmstadtium	110	269			
Roentgenium	111	272			
Copernicium	112	285			
Ununtrium	113	284			
Ununquadium	114	289			
Ununpentium	115	288			
Ununhexium	116	288			
Ununseptium	117	288			
Ununoctium	118	288			
Francium	87	223			
Radium	88	226			
Actinium	89	227			
Thorium	90	232.04			
Protactinium	91	231.04			
Uranium	92	238.03			
Neptunium	93	237			
Plutonium	94	244			
Americium	95	243			
Curium	96	247			
Berkelium	97	247			
Californium	98	251			
Einsteinium	99	252			
Fermium	100	257			
Mendelevium	101	258			
Nobelium	102	259			
Lawrencium	103	262			
Praseodymium	59	140.91			
Cerium	58	140.12			
Neodymium	60	144.24			
Promethium	61	145			
Samarium	62	150.36			
Europium	63	151.96			
Gadolinium	64	157.25			
Terbium	65	158.93			
Dysprosium	66	162.50			
Holmium	67	164.93			
Erbium	68	167.26			
Thulium	69	168.93			
Ytterbium	70	173.05			
Lutetium	71	174.97			
Thorium	90	232.04			
Protactinium	91	231.04			
Uranium	92	238.03			
Neptunium	93	237			
Plutonium	94	244			
Americium	95	243			
Curium	96	247			
Berkelium	97	247			
Californium	98	251			
Einsteinium	99	252			
Fermium	100	257			
Mendelevium	101	258			
Nobelium	102	259			
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Nobelium	102	259			
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Uranium	92	238.03			
Neptunium	93	237			
Plutonium	94	244			
Americium	95	243			
Curium	96	247			
Berkelium	97	247			
Californium	98	251			
Einsteinium	99	252			
Fermium	100	257			
Mendelevium	101	258			
Nobelium	102	259			
Lawrencium	103	262			

Intertek Minerals Services Terms and Conditions (2015)

- 1.0 Unless otherwise specifically agreed in writing Intertek Minerals (hereinafter called "the Company") undertakes services in accordance with these general conditions (hereinafter called "General Conditions") and accordingly all offers or tenders of service are made subject to these General Conditions. All resulting contracts, agreements or other arrangements will in all respects be governed by these General Conditions, except only to the extent that the law of the place where such arrangements or contracts are made or carried out shall preclude any of the General Conditions and in such case such local law shall prevail wherever, but only to the extent that, it is at variance with these General Conditions.
- 1.1 For the purposes of these conditions the term "Intertek Minerals" comprises all of the Intertek subsidiaries carrying out Minerals testing and inspection activities including but not limited to Intertek, Intertek Minerals, Intertek Genalysis, Intertek Testing Services (Australia) Pty Ltd, Intertek Robotic Laboratories Pty Ltd, (IRL), PT Intertek Utama Services (IUS), ITS (PNG) Ltd, Genalysis Laboratory Services Pty Ltd, Genalysis Laboratory Services SA Pty Ltd, Intertek NTEL, Intertek Minerals Limited, Intertek Testing Services Philippines Inc, Intertek Genalysis Namibia (Pty) Ltd, Intertek International Tanzania Ltd, ITS West Africa, Intertek Commodities Botswana, Intertek Genalysis Zambia Ltd, Intertek Genalysis SI Ltd, Intertek Vigalab SpA, Laboratory Services International.
- 2.0 The Company is an enterprise engaged in the trade of inspection and testing. As such, it:
- 2.1 carries out such standard services as are referred to in General Condition 6;
- 2.2 renders advisory and special services as may be agreed by the Company and as referred to in General Condition 7; and
- 2.3 issues reports and/or certificates as referred to in General Condition 8
- 3.0 The Company acts for the persons or bodies from whom the instructions to act have originated (hereinafter called "the Principal"). No other party is entitled to give instructions, particularly on the scope of inspection or delivery of report or certificate, unless so authorized by the Principal and agreed by the Company. The Company will however be deemed irrevocably authorized to deliver at its discretion the report or the certificate to a third party if following instructions by the Principal a promise in this sense had been given to this third party or such a promise implicit follows from circumstances, trade custom, usage or practice.
- 4.0 The Company will provide services in accordance with:
- 4.1 the Principal's specific instructions as confirmed by the Company;
- 4.2 the terms of the Company's Standard Order Form, Sample Submission Form and/or Standard Specification Sheet if used;
- 4.3 any relevant trade custom, usage or practice; and
- 4.4 such methods as the Company shall consider appropriate on technical, operational and/or financial grounds.
- 5.0 5.1 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.
- 5.2 Documents reflecting engagements contracted between the Principal and third parties, or third parties' documents, such as copies of contracts of sale, letters of credit, bills of lading, etc., are (if received by the Company) considered to be for information only, without extending or restricting the mission or obligations accepted by the Company.
- 6.0 The Company's standard services may include all or any of the following:
- 6.1 quantitative and/or qualitative inspection;
- 6.2 inspection of goods, plant, equipment, packing, tanks, containers and means of transport;
- 6.3 inspection of loading or discharging;
- 6.4 sampling;
- 6.5 laboratory analysis or other testing; and
- 6.6 surveys and audits.
- 7.0 Special services where the same exceed the scope of standard services as referred to in General Condition 6 will only be undertaken by the Company by particular arrangement.
- Such special services are illustratively not exhaustively:
- 7.1 qualitative and/or quantitative guarantees;
- 7.2 supply of technicians and other personnel;
- 7.3 pre-shipment inspection under government mandated import or customs schemes; and
- 7.4 advisory services.
- 8.0 8.1 Subject to the Principal's instructions as accepted by the Company, the Company will issue reports and certificates of inspection 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.
- 8.2 Reports or certificates issued following testing or analysis of samples contain the Company's specific opinion on those samples as received only but do not express any opinion upon the bulk from which the samples were drawn. If an opinion on the bulk is requested special arrangements must be made in advance with the Company for the inspection and sampling of the bulk.
- 9.0 The Principal will:
- 9.1 ensure that instructions to the Company and sufficient information are given in due time to enable the required services to be performed effectively;
- 9.2 procure all necessary access for the Company's representatives to enable the required services to be performed effectively;
- 9.3 supply, if required, any special equipment and personnel necessary for the performance of the required services;
- 9.4 ensure that all necessary measures are taken for safety and security of working conditions, sites and installations during the performance of services and will not rely, in this respect, on the Company's advice whether requested or not;
- 9.5 take all necessary steps to eliminate or remedy any obstruction to or interruptions in the performance of the required services;
- 9.6 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; and
- 9.7 fully exercise all its rights and discharge all its liabilities under any related contract whether or not a report or certificate has been issued by the Company failing which the Company shall be under no obligation to the Principal.

- 10.0 The Company shall be entitled at its discretion to delegate the performance of the whole or any part of the services contracted for with the Principal to any agent or subcontractor. Where deemed appropriate by the company, prior consent will be sought from the Principal.
- 11.0 If the requirements of the Principal necessitate the analysis of samples by the Principal's or by any third party's laboratory the Company will pass on the result of the analysis but without responsibility for its accuracy. Likewise where the Company is only able to witness an analysis by the Principal's or by any third party's laboratory the Company will provide confirmation that the correct sample has been analysed but will not otherwise be responsible for the accuracy of any analysis or results.
- 12.0
- 12.1 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.
- 12.2 All samples submitted to the Company remain the property of the principle. The Company shall not be liable for any claim whatsoever relating to deterioration, contamination, damage or loss of samples. The Principle indemnifies the Company against any claims or legal action resulting from damage, deterioration or loss of samples.
- 12.3 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 Fifteen (15) times the amount of the fee or commission paid or payable in respect of the specific service or test required under the particular contract with the Company which gives rise to such claims, or US\$15,000, whichever is least, provided however that the Company shall have no liability in respect of any claims for indirect or consequential loss including loss of profit and/or loss of future business and/or loss of production and/or cancellation of contracts entered into by the Principal. Where the fee or commission payable relates to a number of services and a claim arises in respect of one of those services the fee or commission may be apportioned for the purposes of this paragraph by reference to the estimated time involved in the performance of each service or the value of the individual services.
- 12.4 The limit of liability of the Company under the terms of Condition 12.2 may be increased upon request received by the Company in advance of the performance of the service to such figure as may be agreed upon payment of additional fees equal to an appropriate fraction of the increase in such compensation or as may be agreed upon.
- 13.0 The Principal shall guarantee, hold harmless and indemnify the Company and its officers, employees, agents or subcontractors against all claims made by any third party for loss, damage or expense of whatsoever nature and howsoever arising relating to the performance, purported performance or non-performance of any services to the extent that the aggregate of any such claims relating to any one service exceed the limit mentioned in Condition 12.
- 14.0 Every officer, employee, agent or subcontractor of the Company shall have the benefit of the limitation of compensation and the indemnity contained in these General Conditions and so far as relates to such limitations any contract entered into by the Company is entered into not only on its own behalf but also as agent and trustee for every such person as aforesaid.
- 15.0 In the event that any unforeseen problems or expenditure arise in the course of carrying out any of the contracted services the Company shall be entitled to make reasonable additional charges to cover additional time and cost necessarily incurred to complete the service.
- 16.0
- 16.1 The Principal will punctually pay not later than Thirty (30) days after the relevant invoice date or upon receipt of invoice where credit is not extended or a credit limit is exceeded or within such other period as may have been agreed in writing by the Company all proper charges rendered by the Company failing which interest will become due at the rate of Eighteen per cent (18%) per annum or one and a half percent (1.5%) from the date of invoice until payment.
- 16.2 The Principal shall not be entitled to retain or defer payment of any sums due to the Company on account of any dispute, cross claim or set off which it may allege against the Company.
- 16.3 In the event of any suspension of payment arrangement with creditors, bankruptcy, insolvency, receivership or cessation of business by the Principal the Company shall be entitled to suspend all further performance of its services forthwith and without liability.
- 17.0 In the event of the Company being prevented by reason of any cause whatsoever outside the Company's control from performing or completing any service for which an order has been given or an agreement made, the Principal will pay to the Company:
- 17.1 the amount of all abortive expenditure actually made or incurred; and
- 17.2 a proportion of the agreed fee or commission equal to the proportion (if any) of the service actually carried out and the Company shall be relieved of all responsibility whatsoever for the partial or total non-performance of the required service
- 18.0 The Company shall be discharged from all liability to the Principal for all claims for loss, damage or expense unless suit is brought within twelve (12) months after the date of the performance by the Company of the service which gives rise to the claim or in the event of any alleged non-performance within three (3) months of the date when such service should have been completed.
- 19.0 The Company is neither an insurer nor a guarantor and disclaims all liability in such capacity. Principals seeking a guarantee against loss or damage should obtain appropriate insurance.
- 20.0 No alteration, amendment or waiver of any of these General Conditions shall have any effect unless made in writing and signed by an officer of the Company
- 21.0 Upon completion of testing the company shall provide a report to the principal on the results of the testing. Where requested by the Principal provisional results may be provided however the Principal agrees that those results shall be subject to confirmation in a final report.
- 22.0 The company agrees to take reasonable measures to ensure that the results of Inspection or Testing on behalf of the Principal and any other information provided to the company are kept confidential provided that this provision will not apply where the results or other information are in the public domain.
- 23.0 The Company shall have no responsibility for any action or inaction of any carrier, shipping or delivering any sample to or from the Company premises.
- 24.0 Samples shall be stored free of charge for a period of sixty (60) days after provision of the invoice. Upon expiration of the free storage period, unless otherwise directed by the Principal storage fees and/or disposal charges shall apply.
- 25.0 All data will be retained for a seven (7) year period; fees may apply for retrieval of data if longer than three (3) months after the final report date.

Global Locations

Asia Pacific

Australia

Intertek Genalysis

Perth Minerals Head Office and Laboratory

15 Davison Street, Maddington, Western Australia 6109
Tel: +61 8 9251 8100 | Email: min.aus.per@intertek.com
Sample Deliveries: Gate 6, 16 Davison Street, Maddington, Western Australia 6109

Intertek Robotic Laboratories

Tel: +61 8 9251 8100 | Email: min.aus.irl@intertek.com

Kalgoorlie Sample Preparation Facility

12 Keogh Way, Kalgoorlie, Western Australia 6430
Tel: +61 8 9021 6057 | Email: min.aus.kal@intertek.com

Port Hedland Inspection and Sample Preparation

116 Pinnacles Street Wedgefield, Western Australia 6721
Tel: +61 8 9172 4288 | Email: hedland@intertek.com

Adelaide Laboratory

11 Senna Road, Wingfield, South Australia 5013
Tel: +61 8 8162 9714 | Email: min.aus.adl@intertek.com

Townsville Laboratory

9-23 Kelli Street, Bohle, Queensland 4818
Tel: +61 7 4774 3655 | Email: min.aus.tsv@intertek.com

Darwin Laboratory (NTEL)

55 Export Drive, Berrimah, Northern Territory 0828
Tel: +61 8 8947 0510 | Email: ntel@intertek.com

Alice Springs Sample Preparation Facility

41 Ghan Rd, Alice Springs, Northern Territory, 0870
Tel: +61 8 8952 3938 | Email: min.aus.asp@intertek.com

China

Shanghai Head Office & Coal Laboratory

Tel: +86 21 6127 6288 | Email: adam.huang@intertek.com

Tianjin Mineral and Coal Laboratory

Tel: +86 22 2532 7795 | Email: roy.zhang@intertek.com

Urumqi Sample Preparation Facility

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Qingdao Inspection and Sample Preparation Facility

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Ningde Inspection and Sample Preparation Facility

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Guangzhou Coal Laboratory

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Lianyungang Office and Inspection

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Rizhao Office and Inspection

Tel: +86 18905326726 | Email: stephen.lui@intertek.com

Indonesia

Jakarta Minerals Head Office and Laboratory

Tel: +62 21 2938 4454 | Email: indo.office@intertek.com

Jakarta Environmental Laboratory

Tel: +62 21 2938 4454 | Email: min.idn.jkt@intertek.com

Samarinda East Kalimantan Coal Laboratory

Tel: +62 541 273111 | Email: min.idn.jkt@intertek.com

Sumbawa (West Nusa Tenggara) Sample Preparation Facility

Tel: +62 371 626475 | Email: min.idn.jkt@intertek.com

Padang (West Sumatra) Sample Preparation Facility

Tel: +62 751 496343 | Email: min.idn.jkt@intertek.com

Manado (North Sulawesi) Sample Preparation Facility

Tel: +62 431 815431 | Email: min.idn.jkt@intertek.com

Kendari (SE Sulawesi) Inspection and Sample Preparation Facility

Tel: +62 811 1587259 | Email: min.idn.jkt@intertek.com

Malaysia

Kuantan Sample Preparation Facility

Tel: +603 33251330 | Email: Muhamad.Othman@intertek.com

Papua New Guinea

LAE Laboratory

Tel: +675 472 8113 | Email: min.png.lae@intertek.com

Philippines

Manila Minerals Head Office and Laboratory

Tel: +63 2 8423464 | Email: min.apac.phl.lab@intertek.com

Surigao Sample Preparation Facility

Tel: +63 928 507 9224 | Email: min.apac.phl.lab@intertek.com

General Santos Sample Preparation Facility

Tel: +63 82 552 4513 | Email: min.apac.phl.lab@intertek.com

Solomon Islands

Solomon Islands Sample Preparation Facility

Tel: +677 39234 | Email: min.slb@intertek.com

South Korea

Seoul Inspection and Head Office

Tel: +82 2 860 0271 | Email: raymond.sohn@intertek.com

Thailand

Bangkok Head Office

Tel: +66 (2) 279 5040 | Email: wilai.suphasin@intertek.com

North and South America

Brazil

Nova Lima Minerals Office

Tel: +55 31 3581-8854 | Email: fernanda.moreiran@intertek.com

Canada

Vancouver Coal Laboratory

Tel: +1 604 454 9011 | Email: vancouver.ops@intertek.com

Prince Rupert Coal Laboratory

Tel: +1 604 454 9011 | Email: vancouver.ops@intertek.com

Thunder Bay Coal Inspection and Sample Preparation

Tel: +1 807 345 5392 | Email: peggy.brown@intertek.com

Montreal Coal Inspection and Sample Preparation

Tel: +1 517 640 6332 | Email: .operationsmtl@intertek.com

Chile

Intertek Vigalab Copiapó

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