intertek minerals

Schedule of Services & Charges 2025

Minerals Services
Africa, ZAR

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 46,000 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.

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

100 Countries.
1000 Laboratories.
46,000 Employees.

Intertek Minerals
Global Centre of Excellence

A new technology and innovation centre with a focus on automation and sustainability to provide our clients with faster, safer, higher quality, and more efficient analytical solutions.

Minerals Global Centre of Excellence, is located in Perth, Western Australia, a key global centre for the minerals and mining industry. This new bespoke space consolidates Minerals operations into a 20,000sqm facility housing over 500 employees. The state-of-the-art laboratory will support our customers in the mining and minerals industry, giving them access to trusted expertise in mineral testing, inspections and analysis. Providing a broad portfolio of services under one roof significantly enhances delivery of our Total Quality Assurance (TQA) customer promise and streamlines our superior customer service.

The new facility was established to inspire innovation and sustainability across the minerals supply chain, with advanced technology, automation and robotics.

Robotics and Automation

As the leader in operating automated robotic laboratory systems for the mining industry, Intertek's new facility includes eight robotic automated systems, including sample preparation, XRF and wet chemistry systems. Utilising advanced technology and innovation with a strong focus on automation, Intertek provides our customers with faster, more efficient analytical options that increase production without compromising on quality.

Specialised testing services

- Supporting the industry to drive a low carbon society.
- Rare earth and alkali earth and battery metals utilising a range of cutting-edge geochemistry techniques.
- High-quality analysis of platinum group elements.
- Consultative customised solutions.

MineralSpace

A key feature of the new Intertek Minerals Global Centre of Excellence is MineralSpace, a unique multifunctional dedicated customer space. This collaborative, immersive and multiple configurational venue is available to our customers and industry bodies for presentations, technical seminars, workshops and events.

- Multiple configurable venue space.
- 4.8-metre interactive screen allowing 32 separate touchpoints.
- Instant access to our world-class technical experts and services.

Sustainability

True to our purpose, Bringing Quality, Safety and Sustainability to Life, this new facility features 3030 x330W solar panels making it one of largest rooftop solar installations in Western Australia. The facility will also capture and recycle laboratory wastewater to conserve this precious resource.

Technology and Innovation

Minalyzer CS

Partnering with Minalyze has allowed Intertek Minerals to install a Minalyzer CS into our Global Centre of Excellence allowing our clients geological data acquisition and access to related software for data visualisation.

MINALYZE

Minalyzer CS is a scanner which is a contactless and non-destructive service that generates geochemistry, high-resolution images, rock quality designation (RQD), structures, specific gravity and bulk density for drill cores and other drill samples. The patented scanner is designed for handling large volumes of drill samples and is capable of scanning drill cores directly in core trays. A laser (LiDAR) generates a 3D-model of the topology of the core and trays, which enables the control and precision of the continuous XRF scanning. RQD and structures are also derived based on the 3D-model.

The objective, continuous and consistent nature of the datasets as well as the high but compact data density generated by the scanning technology is paramount in machine learning and deep learning applications and approaches to geology. Machine learning and deep learning have been demonstrated to be effectively used, based on the data from the scanning, for the prediction of host rock lithologies.

A range of datasets are available generated from one scan;

- **Photography:** High-resolution digital image of sample of spatial resolution of 12 pixels/mm with consistent light conditions.
- **Topography:** High-resolution grey scale or colorized digital topology model of sample in 3D X,Y and Z point cloud format.
- **Chemical Analysis:** Continuous X-ray Fluorescence (XRF) analysis on 1 m, 10 cm and custom intervals. Elemental range between Sodium (Na) to Uranium (U) depending on settings.
- **Specific Gravity/Bulk Density:** Specific Gravity (SG) estimations using the X-SG method or bulk density using volumetric estimation depending on core type.
- **Rock Quality Designation:** Rock quality designation (RQD) on desired intervals. Client can generate it digitally by using Minalogger and designating which fractures are mechanical or natural.
- **Structural logging:** Measurement of Alpha and Beta angles on structural features. Client can measure it digitally by using Minalogger where core have orientation line, and Alpha angle could be measured on.

Access to the Minalyze cloud-based software www.minalogger.com can be provided for visualisation and generation of datasets through digital tools and allows for remote access to a digital version of the drill sample.

Chrysos PhotonAssay

Chrysos PhotonAssay technology added to Minerals Global Centre of Excellence in Perth and Tarkwa Minerals Laboratory.

CHRYSOS PhotonAssay

Intertek Minerals has partnered with Chrysos Corporation to install four Chrysos PhotonAssay units at the new Minerals Global Centre of Excellence and an additional two units currently being commissioned in Ghana, one unit at the Tarkwa Minerals Laboratory and one at a dedicated client site.

Using much higher energies than traditional X-ray methods, Chrysos PhotonAssay detects and counts atoms of gold in as little as two minutes. PhotonAssay allows large samples to be measured and provides a true bulk reading independent of the chemical or physical form of the sample. Using uniquely numbered sample jars, the process is completely non-destructive, and all samples can be retained for further analysis or testing if required. The technology is also measurably safer and more environmentally friendly than previous assay processes, something that aligns with Intertek's stated purpose of bringing quality, safety, and sustainability to life.

For gold producers Chrysos PhotonAssay delivers faster, more accurate gold analysis on larger samples with lower costs.

- More representative sample analysis and results
- Improved definition of reserves and resources
- Lower labour requirements, less chance of human error and/or accident
- Reduced supply chain cost, reliance and management

Applications

The most common methods offered are listed in this Schedule, however this is not an exhaustive list of services and not all services are available at all locations, We encourage clients to discuss their projects with us and where possible visit the laboratories to assist with the selection of the most appropriate analytical solutions for the particular application.

Contents

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 52 and submission forms can be downloaded from the Intertek website www.intertek.com/minerals

To assist in improving our service to you please ensure sample submissions are clearly labelled, well packaged and submitted in a sequential order. Please also ensure written instructions and freight information are supplied via email or accompany the samples on delivery to facilitate effective and timely processing of your samples. Sample submissions that are poorly labelled, packaged or provided in non-sequential manner may incur additional sorting charges.

Description	Code	Price
Quarantine treatment – pulps or samples in standard paper packets	QS01	R15.64/500g
Quarantine treatment - bulk samples per 3kg	QS02	R93.85
Sample pick up and transport	TP01	POA
Environmental waste disposal levy	WL	R15.64/per sample

The prices specified relate to Class 2 waste disposal facility, additional charges will apply if samples are required to be disposed at a higher-class facility.

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 www.intertek.com/minerals 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	AP04	Batch fee R934.00
Fibrous Material (Asbestos) requiring preparation	AP05	Batch fee R3748.31
Fibrous Material (Asbestos) weighing of sample	APW	R55.86 per method/per sample
Naturally Occurring Radioactive Material (NORM) received as pulps	RM04	Batch fee R934.00
Naturally Occurring Radioactive Material (NORM) requiring preparation	RM05	Batch fee R3748.31
Naturally Occurring Radioactive Material (NORM) weighing of sample	RMW	R55.87 per method/per sample
Disposal of fibrous material	APD	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. Disposal of samples will incur a charge. 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.

The prices specified relate to Class 2 waste disposal facility, additional charges will apply if samples are required to be disposed at a higher-class facility.

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.

Sort, Dry and Pulverise Packages

Description	Code	Price
Dry, pulverise up to 300g	SP01	R80.44
Dry, pulverise 300g up to 1.2kg	SP02	R94.96
Dry, pulverise 1.2kg up to 3kg	SP03	R117.31
Additional wt >1.2kg: dry, split, pulverise up to 1.2kg, discard coarse	SP68	R16.76/kg
Additional wt >1.2kg: dry, split, pulverise up to 1.2kg, retain coarse	SP66	R21.79/kg
Additional wt >3kg: dry, split, pulverise up to 3kg, discard coarse	SP05	R16.76/kg
Additional wt >3kg: dry, split, pulverise up to 3kg, retain coarse	SP08	R21.79/kg

Quartz wash packages are available on request

Sort, Dry, Crush/Split and Pulverise Packages

Description	Code	Price
Dry, crush ~2mm, pulverise up to 300g	SP61	R107.25
Dry, crush ~2mm, pulverise 300g up to 1.2kg	SP62	R121.78
Dry, crush ~2mm, pulverise 1.2kg up to 3kg	SP64	R144.12
Additional wt >1.2kg: dry, crush ~2mm, split, pulverise up to 1.2kg, discard coarse	SP69	R11.73/kg
Additional wt >1.2kg: dry, crush~2mm, split, pulverise up to 1.2kg, retain coarse	SP67	R16.76/kg
Additional wt >3kg: dry, crush~2mm, split, pulverise up to 3kg, discard coarse	SP18	R11.73/kg
Additional wt >3kg: dry, crush~2mm, split, pulverise up to 3kg, retain coarse	SP15	R16.76/kg

Sort, Dry, Crush/Split PhotonAssay Package

Description	Code	Price
Dry, crush ~2mm, split for PhotonAssay jar (1), discard coarse - RC	PA-D	R34.63 +R30.72/kg
Dry, crush ~2mm, split for PhotonAssay jar (1), retain course - RC	PA-R	R39.10 +R30.72/kg
Dry, crush ~2mm, split for PhotonAssay jar (1), discard coarse - drill core	PADC-D	R37.99 +R32.96/kg
Dry, crush ~2mm, split for PhotonAssay jar (1), retain course - drill core	PADC-R	R42.45 +R32.96/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
Drying samples received in standard paper packets	DP105	R10.06 +R10.06/kg
Sort and dry samples	DR105	R10.06 +R10.06/kg
Low temperature drying - 45°C	DR45	R13.41/kg +R13.41/kg
Low temperature drying - 80°C	DR80	R13.41/kg +R13.41/kg
Dry and desiccate	SD06	R22.34

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
Coarse crush to ~10mm	CRC01	R10.06 +R10.06/kg
Fine crush to ~2mm	CRF01	R17.88 + R17.88/kg
Crusher clean (barren material)	CRW01	R34.63

*Typically 70% passing, finer crush available on request

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 Splitter 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	R44.69
Riffle splitting – Up to 6kg retain reject	RF02	R61.45
Additional riffle splitting options		POA
Rotary or linear splitting	RL01	R55.86 + R8.94/kg
Split sample using a fine crusher splitter combination	CRRS	R5.59/kg
Packaging per additional rotary splitting subsample	RSPAK	R44.69/subsample

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	R80.44
300g to 1.2kg	PU02	R92.73
1.2 to 3kg	PU03	R107.25
Additional weight per 3kg or part thereof	PU05	R107.25 + R107.25/3kg
WC bowl 100g	WC01	R182.11
Zr bowl 100g	ZR01	R182.11
Quartz wash (discarded)	QW01	R51.39
Quartz wash (retained)	QW02	R71.50

Size Analysis

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 per screen up to 3kg, discard	SV40	R150.83 per screen*
Dry sieve per screen up to 3kg, retain undersize	SV41	R288.25 per screen*
Dry sieve per screen up to 3kg, retain oversize	SV42	R288.25 per screen*
Dry sieve per screen up to 3kg, retain both over and undersize	SV43	R414.49 perscreen*
Wet sieve (retain oversize only)	SV13	R341.87/kg per screen
Wet sieve (retain undersize only)	SV14	R341.87/kg per screen
Wet sieve (recovering undersize and oversize)	SV15	R479.29/kg per screen

*Up to 3kgs, then hourly rate will be charged. Other screenings available on request

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	R96.08
Laser particle size analyser to confirm sample prep grind quality passing 75µm*	SV17	R46.92
QA Crush passing nominal 10mm - Jaw Crusher	QACR01	R55.86
QA Crush passing nominal 2mm - Boyd Crusher	QACR02	R69.27

* 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	R1675.85/hr
Other core cutting services		POA

Miscellaneous Procedures

Description	Code	Price
Compositing	CM01	R1340.68/hr
Reporting weights of samples	WT01	R20.11

Gravimetric Determinations

Element	Description	Detection Limit	Code	Price
LOD	Loss on drying (105°C or client nominated temperature) 10g or less	0.01%	LOD/GR1	R201.10
LOD	Loss on drying (105°C or client nominated temperature) to constant weight 10g or less	0.01%	LOD/GR1X	R335.17
LOD	Loss on drying (105°C or client nominated temperature)	0.01%	LOD105_P/GR	R167.58 + R33.52/kg
LOD	Loss on drying (105°C or client nominated temperature) to constant weight	0.01%	LOD105_P/GRX	R335.17 + R33.52/kg
LOI	Loss on ignition muffle (1000°C or client nominated temperatures) on an as received basis*	0.01%	LOI/GR	R136.30 per point
LOI	Loss on ignition TGA (1000°C or client nominated temperatures)	0.01%	/TGA	R136.30
	Multiple temperatures each additional			R34.63

* For LOI non-routine sample. Matrices may require pre-determination of LOD before LOI analysis, therefore additional charges may apply.

Density

Element	Description	Detection Limit	Code	Price
DE	Density / core and rocks uncoated		DE/GR	R214.51
DE	Density / core and rocks wax coated		DEW/GR	R479.29
SG	Specific gravity / core and rocks uncoated		SG/GR	R214.51
SG	Specific gravity / core and rocks wax coated		SGW/GR	R479.29
SG	Pulp density (gas pycnometer method)		SGP/PYC	R201.10
SG	Liquid specific gravity		SGL/GR	R284.89

Photon Procedures

Description	Code	Price
Photon jar	PH_JAR	R13.41
Additional split from original sample	PA_SPT	R20.11
Additional re-split of sample	PA_RSPT	R34.63

Portable XRF Scan

Portable XRF technology provides rapid, reliable semi-quantitative scan data on a prepared pulp sample while quantitative analytical suites are conducted. Analysing correctly-prepared pulps in a controlled laboratory environment minimises process variability in contrast with in-field analysis of un-prepared materials using battery operated units. A total of 37 elements are reported using a Geo-exploration mode i.e. calibrated for low level silicate matrix samples. Other custom instrument calibrations can be made available on request. Sample preparation charges are in addition to the XRF scan.

Description	Code	Price
Ag, Al, As, Ba, Bi, Ca, Cd, Ce, Co, Cr, Cu, Fe, Hg, K, La, Mg, Mn, Mo, Nb, Ni, P, Pb, Rb, S, Sb, Se, Si, Sn, Sr, Th, Ti, U, V, W, Y, Zn, Zr.	pXscanE	R91.61

Portable XRF data are subject to limitations, for stand-alone portable XRF scan analysis we recommend all significant or anomalous data be checked by conventional methods.

Minalyzer CS Analyzer

Minalyzer CS is a scanner which is a contactless and non-destructive service that generates geochemistry, high-resolution images, rock quality designation (RQD), structures, specific gravity and bulk density for drill cores and other drill samples. The core will be scanned to pre-agreed settings and configuration by Intertek personnel and quantified with involvement from Minalyze. The core will be sent for sub-sequent analysis by the client using conventional techniques. Primary calibration will be based on pressed pellets of OREAS 24B and OREAS 624. After scanning a sub-set of the assays spanning over the range of elements and quantities will be used as a custom calibration.

Continuous XRF Core Scanning

Scanning of core with high resolution camera as well as the LiDAR and a continuous XRF measurement along the core. There are different options of detectors, X-ray tubes and atmosphere conditions available that determine the elemental range and detection limits delivered. This enables calculation of RQD and Structural Logging through Minalogger Cloud. Standard speed is 10 mm/s and highest resolution quantified intervals would be 10cm intervals. Helium purge can be added for improved detection on lighter elements Na, Mg, Al, Si and P.

Description	Code	Price
Minalyze XRF scan	MINZ-01	R301.65 per meter
Minalyze XRF scan with Helium purge	MINZ-01HP	R335.17 per meter
Minalyze scan two settings	MINZ-02	R413.38 per meter
Minalyze scan two settings with Helium purge	MINZ-02HP	R446.89 per meter

Delivered datasets, photography, topology and elemental analysis. Enables, volume bulk density/X-SG, rock quality designation and structural logging.

High-Resolution XRF Core Scanning

Scanning of core with high resolution camera as well as the LiDAR and a continuous XRF measurement along the core in high-resolution. There are different options of detectors, X-ray tubes and atmosphere conditions available that determine the elemental range and detection limits delivered. This enables calculation of RQD and Structural Logging through Minalogger Cloud. Standard speed is 1 mm/s and highest resolution quantified intervals would be 1 cm intervals. Helium purge can be added for improved detection on lighter elements Na, Mg, Al, Si and P.

Description	Code	Price
Minalyze high-resolution scan	MINZ-HR	R1228.95 per meter
Minalyze high-resolution scan with Helium purge	MINZ-HRHP	R1340.68 per meter

Delivered datasets, photography, topology and elemental analysis. Enables, volume bulk density/X-SG, rock quality designation and structural logging.

Photography and Topology Core Scanning

This service includes scanning of core with high-resolution camera as well as the LiDAR, generating a sample photograph as well as a point cloud 3D model of the sample. This enables calculation of RQD and Structural Logging through Minalogger Cloud.

Description	Code	Price
Photography and topology	MINZ-PT	R279.31 per tray

Delivered datasets, photography and topology. Enables, volume bulk density/X-SG, rock quality designation and structural logging.

Volume Bulk Density Core Scanning

Calculation of material bulk density per core tray. The core tray is weighed before scanning, and the LiDAR topology dataset is used to derive the sample volume in the tray. It requires at least a topology and photography service to have been performed. This method works well on friable and broken material.

Description	Code	Price
Volume bulk density	MINZ-VBD	R111.72 per tray

X-SG Specific Gravity Core

Calculation of specific gravity on desired intervals along the drill core. This service requires a continuous X-ray Fluorescence scan to have been performed on the intervals of interest. A calibration dataset must be provided with known Specific Gravity for a sub-set of the cores that are being scanned either based on pycnometry or submersion methods. This method works well on crystalline and competent core.

Description	Code	Price
X-SG specific gravity	MINZ-XSG	R27.93 per meter

Point XRF Chips and Pulp Core Scanning

Scanning of RC chips or pulps with high-resolution camera and a point XRF measurement in each compartment of a standard chip tray. There are different options of detectors, X-ray tubes and atmosphere conditions available that determine the elemental range and detection limits delivered. Helium purge can be added for improved detection on lighter elements Na, Mg, Al, Si and P.

Description	Code	Price
XRF chips and pulp scanning	MINZ-CPS	R893.78 per tray
XRF chips and pulp scanning with Helium purge	MINZ-CPSHP	R1117.23 per tray

Delivered datasets, photography, topology and elemental analysis.

MINALOGGER – WEB BASED CLOUD SOFTWARE

A cloud-based software www.minalogger.com is available for visualisation and generation of datasets through digital tools which facilitates remote access to a digital version of drill samples. Intertek can refer clients to Minalyze for Minalogger licencing options.

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. Please contact us to discuss your specific requirements.

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	-	350ppm	FA25/OE04	R202.22
	50g fire assay / ICP-OES	0.005ppm	-	175ppm	FA50/OE04	R212.27
Au	25g fire assay / ICP-MS	1ppb	-	350ppm	FA25/MS02	R268.14
	50g fire assay / ICP-MS	1ppb	-	175ppm	FA50/MS02	R279.31
Au, Pt, Pd	50g fire assay / ICP-OES	1ppb	-	20ppm	FA50/OE	R284.89
Au, Pt, Pd	25g fire assay / ICP-MS	1ppb, 0.5ppb, 0.5ppb	-	350ppm	FA25/MS	R290.48
	50g fire assay / ICP-MS	1ppb, 0.5ppb, 0.5ppb	-	175ppm	FA50/MS	R301.65
Rh	25g fire assay / ICP-OES	5ppb	-	350ppm	FA25P/OE	R357.51

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 fire 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/OE1	R949.65
	1kg Screen fire assay 100µm / ICP-OES		SF100/OE1	R1017.80
	1kg Screen fire assay 75µm / ICP-OES		SF75/OE1	R1243.48
	Additional oversize firing			R223.45
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	25g NiS fire assay low level / ICP-MS	2ppb - 500ppb	NS25L/MS	R2066.88
Pt, Pd, Rh, Ru, Ir, Os		1ppb - 500ppb		
Au	25g NiS fire assay ore grade / ICP-MS	5ppb - 100ppm	NS25H/MS	R2066.88
Pt, Pd, Rh, Ru, Ir, Os				

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	R218.98
	25g aqua regia / enhanced MS		AR25/eMS	R261.43
Au	10g aqua regia / MS	1ppb	AR10/aMS	R155.29
	25g aqua regia / MS		AR25/aMS	R197.75
Au	10g aqua regia / MS	0.01ppm	AR10/hMS	R113.96
	25g aqua regia / MS		AR25/hMS	R155.29
	Pre-roasting (ashing) to remove graphitic / other organic material		R/	R67.03

PhotonAssay Analysis

ChrysosTM PhotonAssay is a high-energy X-ray source that is used to irradiate large mineral samples, typically about 0.5 kg. The X-rays induce short-lived changes in the structure of any gold nuclei present. As the excited gold nuclei return to their ground state, they emit a characteristic gamma-ray signature, the intensity of which is directly proportional to the concentration of gold.

The penetrating nature of ChrysosTM PhotonAssay provides much higher energy than those used in conventional X-ray fluorescence (XRF), which provides a true bulk analysis of the entire sample. Samples are presented into a fully automatic process where samples are irradiated, measured, data collection and reporting.

Element	Description	Detection Limit	Code	Price
Au	Standard gold analysis 2 cycle	0.03ppm - 350ppm	PAAU02	R212.27

The nominal 2 sigma Lower Detection Limit (LDL) for Au is 0.02-0.03 ppm, for samples with low concentrations of interfering elements, namely a combined U and Th concentration of less than 15 ppm and Ba concentration of less than 3,000 ppm. Elevated U, Th, Ba levels will increase detection limit and decrease precision.

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	10g leach / ICP-MS (suited to ultrafines)	0.01ppb	CN10/MS	R292.71
	100g leach / ICP-MS		CN100/MS	R305.00
	500g leach / ICP-MS		CN500/MS	R365.33
	1.0kg leach / ICP-MS		CN1000/MS	R415.61
	2.0kg leach / ICP-MS		CN2000/MS	R490.46
	4.0kg leach / ICP-MS		CN4000/MS	R720.61
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	R16.76

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	R206.69
	400g leach / ICP-MS		LW400/MS	R235.74
	1000g leach / ICP-MS		LW1000/MS	R367.57
Ag	As an additional element	1ppm	/MS	R16.76
Cu	Cu an additional element	5ppm	/MS	R16.76

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	R449.13
	400g wash / grind / fire assay / ICP-OES		TR400/OE	R455.83
	1000g wash / grind / fire assay / ICP-OES		TR1000/OE	R521.75

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.

The most commonly used analytical procedures are listed, however this is not an exhaustive list and we encourage you to contact your local manager to discuss your specific requirements. Not all methods and packages listed are available at all locations.

Low Level Triple Quad Analysis

The Agilent 8800 triple quad (QQQ) ICPMS exemplifies the Intertek philosophy of continual process improvement with the commercialisation of this widely-embraced leading-edge analytical technology. Elimination of polyatomic species interferences has made significant advances with the introduction of ICPMS instrumentation with collision cells, allowing for the accurate quantification of geochemically and environmentally critical elements as well as deleterious trace elements, at very low levels, in a wide variety of sample types. However, some geological analytical applications require better sensitivity for certain elements and the elimination of interferences in complex matrices. The tandem configuration of the QQQ ICPMS has an octapole collision-reaction cell (CRC) between two quadrupole mass analysers which allows for the elimination of these vexatious interferences by reacting the analyte or interfering ions to another mass with a reactive gas. This, overcomes interferences issues with doubly charged ions and intense dimers of oxygen, nitrogen and argon where the collision cell alone is ineffective. Diverse applications of the triple quad ICPMS include the determination of sulphur and phosphorus at ultra-low levels, low level silicon determination, analysis of chlorine in geological samples and the quantification of arsenic and selenium in rare earth ores.

Triple Quad 53 Element Aqua Regia ICP-MS Package

Element	Range ppm			Element	Range ppm			Element	Range ppm		
Au	0.1ppb	-	2	Hf	0.002	-	1000	S	2	-	5%
Ag	0.01	-	250	Hg	0.002	-	100	Sb	0.005	-	5000
Al	0.0001%	-	10%	In	0.002	-	1000	Sc	0.005	-	2500
As	0.03	-	5000	K	0.0005%	-	5%	Se	0.01	-	5000
B	0.5	-	1%	La	0.002	-	2500	Sn	0.02	-	1000
Ba	0.05	-	2000	Li	0.02	-	2500	Sr	0.01	-	5000
Be	0.005	-	1000	Mg	0.0005%	-	20%	Ta	0.005	-	1000
Bi	0.005	-	5000	Mn	0.2	-	2%	Te	0.002	-	1000
Ca	0.0001%	-	40%	Mo	0.01	-	5000	Th	0.001	-	2500
Cd	0.002	-	1000	Na	0.001%	-	5%	Ti	1	-	1%
Ce	0.002	-	5000	Nb	0.002	-	1000	Tl	0.005	-	1000
Co	0.01	-	1%	Ni	0.04	-	2%	U	0.001	-	5000
Cr	0.1	-	2%	P	2	-	2%	V	0.02	-	1%
Cs	0.01	-	1000	Pb	0.005	-	5000	W	0.01	-	1000
Cu	0.05	-	2%	Pd	1ppb	-	500ppb	Y	0.001	-	2000
Fe	0.0002%	-	50%	Pt	2ppb	-	500ppb	Zn	0.2	-	2%
Ga	0.005	-	1000	Rb	0.005	-	1000	Zr	0.01	-	1000
Ge	0.01	-	1000	Re	0.0002	-	500				
Aqua regia digestion 0.5g					AR005/MSQ53						R491.58

Rare Earth Elements (REE) 12 Element Add On

Element	Range ppm			Element	Range ppm			Element	Range ppm		
Pr	0.001	-	1000	Gd	0.001	-	1000	Er	0.001	-	1000
Nd	0.001	-	1000	Tb	0.001	-	1000	Tm	0.001	-	1000
Sm	0.001	-	1000	Dy	0.001	-	1000	Yb	0.001	-	1000
Eu	0.001	-	1000	Ho	0.001	-	1000	Lu	0.001	-	1000
REE add on					AR005/MSQ53R						R131.83

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

Triple Quad Four Acid 48 Element Package

Element	Range ppm			Element	Range ppm			Element	Range ppm		
Ag	0.05	-	500	Hf	0.01	-	2000	Sb	0.02	-	1%
Al	10	-	15%	In	0.01	-	2000	Sc	0.05	-	5000
As	0.2	-	1%	K	10	-	10%	Se	0.05	-	1%
Ba	0.1	-	5000	La	0.01	-	5000	Sn	0.1	-	2000
Be	0.05	-	2000	Li	0.1	-	5000	Sr	0.1	-	1%
Bi	0.01	-	1%	Mg	10	-	40%	Ta	0.01	-	2000
Ca	20	-	40%	Mn	0.5	-	5%	Te	0.005	-	2000
Cd	0.01	-	2000	Mo	0.05	-	1%	Th	0.01	-	5000
Ce	0.01	-	1%	Na	10	-	10%	Ti	1	-	2%
Co	0.1	-	2%	Nb	0.01	-	2000	Tl	0.01	-	2000
Cr	0.2	-	2%	Ni	0.5	-	2%	U	0.005	-	1%
Cs	0.05	-	2000	P	50	-	5%	V	0.05	-	2%
Cu	0.5	-	2%	Pb	0.5	-	1%	W	0.05	-	2000
Fe	10	-	50%	Rb	0.05	-	2000	Y	0.01	-	2000
Ga	0.01	-	2000	Re	0.002	-	2000	Zn	1	-	2%
Ge	0.1	-	2000	S	10	-	10%	Zr	0.05	-	2000
Four Acid 48 element package					4A/MSQ48						R566.44

RARE EARTH ELEMENTS (REE) 12 ELEMENT ADD ON

Element	Range ppm			Element	Range ppm			Element	Range ppm		
Pr	0.005	-	5000	Gd	0.005	-	2000	Er	0.005	-	2000
Nd	0.01	-	5000	Tb	0.005	-	2000	Tm	0.005	-	2000
Sm	0.01	-	5000	Dy	0.01	-	2000	Yb	0.01	-	2000
Eu	0.005	-	2000	Ho	0.005	-	2000	Lu	0.01	-	2000
REE add on					4A/MSQ48R						R131.83

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

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		
Au	0.1ppb	-	2	Hf	0.01	-	1000	S	500	-	5%
Ag	0.02	-	250	Hg	0.01	-	100	Sb	0.02	-	5000
Al	0.005%	-	10 %	In	0.01	-	1000	Sc	0.02	-	2500
As	0.05	-	5000	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	R441.31

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	R131.83

Element
Ag, Al, As, Ba, Bi, Ca, Cd, Ce, Co, Cr, Cu, Fe, Hg, K, La, Mg, Mn, Mo, Nb, Ni, P, Pb, Rb, S, Sb, Se, Si, Sn, Sr, Th, Ti, U, V, W, Y, Zn, Zr.

Portable XRF scan add on	pXscanE	R91.61

Description	Code	Price
Bundled Ultima package (65 elements and pXRF scan)	ARpX02	R598.84

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 many geological 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	R264.22
Aqua regia digestion 10g	AR10/OE32	R279.31
Aqua regia digestion 25g	AR25/OE32	R338.52

Aqua Regia 33 Element including Gold Package

Element	Range ppm			Element	Range ppm			Element	Range ppm		
Au	1ppb	-	2	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	R324.00
Aqua regia digestion 10g / ICP-MS	AR10/MS33	R338.52
Aqua regia digestion 25g / ICP-MS	AR25/MS33	R396.62
Low S (50ppm) Option*		
Aqua regia digestion 1g	AR1/OM33	R382.09
Aqua regia digestion 10g	AR10/OM33	R396.62
Aqua regia digestion 25g	AR25/OM33	R455.83

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	-	2	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	R455.83
Aqua regia digestion 10g	AR10/MS52	R470.35
Aqua regia digestion 25g	AR25/MS52	R528.45
Low S (50ppm) Option*		
Aqua regia digestion 1g	AR1/OM52	R513.93
Aqua regia digestion 10g	AR10/OM52	R528.45
Aqua regia digestion 25g	AR25/OM52	R588.22

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	R131.83

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	R140.77
Aqua regia digestion 10g	/ ICP first element	AR10/OM	R155.29
Aqua regia digestion 25g	/ ICP first element	AR25/OM	R197.75
Aqua regia digestion 1g, 10g, 25g	/ secondary instrument first element		R106.14
	/ per additional element		R11.17
Au as an additional element	10g or 25g options / enhanced MS (0.1ppb)	AR10 or AR25/eMS01	R64.80

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						R325.11

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						R508.34
Low level S 50ppm option*					4A/OM48						R565.32

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						R131.83

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	4A/OM	R218.98
	/ secondary instrument first element		R106.14
	/ per additional element		R11.17

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 R537.39

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 R635.70

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

Partial Digest 58 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 or TL8/OM58	R778.71
TL7/OM59	R792.12

*Na is only reported on TL7 digest

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	TL1, TL6, TL7 or TL8	R282.10
	/ secondary instrument first element		R120.10
	/ per additional ICP element		R16.76

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

Battery & Energy Metals

With the push towards a net zero future, the production of renewable energy sources is becoming increasingly more important. Technologies such as wind power, solar power, and batteries need a wide range of minerals to produce. Often these minerals have unique properties that cause difficulties when quantifying compositions using traditional methodology. This section is designed for you to pick the most suitable package when you need to analyse your battery and energy minerals. Included in this section are packages for both exploration and ore grade lithium, full quantification and ion exchangeable rare earths, uranium analysis, and graphites.

Lithium

Lithium is a commodity of interest in the renewable energy sector being a major component in batteries. Two packages are available for the quantification of lithium; an exploration package using a multi-acid digest to achieve the necessary low detection limits, and an ore grade package using a peroxide fusion to ensure that accuracy and precision is achieved at higher concentrations.

48 Element Lithium Exploration Package

Element	Range ppm	Finish	Element	Range ppm	Finish	Element	Range ppm	Finish
Li	0.1 - 1%	MS	Ge	0.1 - 2000	MS	Sb	0.05 - 1%	MS
Ag	0.05 - 500	MS	Hf	0.05 - 2000	MS	Sc	0.1 - 5000	MS
Al	50 - 15%	MS	In	0.01 - 2000	MS	Se	0.5 - 1%	MS
As	0.5 - 1%	MS	K	20 - 10%	MS	Sn	0.1 - 2000	MS
Ba	0.1 - 5000	MS	La	0.01 - 5000	MS	Sr	0.05 - 1%	MS
Be	0.05 - 2000	MS	Mg	20 - 40%	MS	Ta	0.01 - 2000	MS
Bi	0.01 - 1%	MS	Mn	1 - 5%	MS	Te	0.2 - 2000	MS
Ca	50 - 40%	MS	Mo	0.1 - 1%	MS	Th	0.01 - 5000	MS
Cd	0.02 - 2000	MS	Na	20 - 10%	MS	Ti	5 - 2%	MS
Ce	0.01 - 1%	MS	Nb	0.05 - 2000	MS	Tl	0.02 - 2000	MS
Co	0.1 - 2%	MS	Ni	0.5 - 2%	MS	U	0.01 - 1%	MS
Cr	1 - 2%	MS	P	50 - 5%	MS	V	1 - 2%	MS
Cs	0.05 - 2000	MS	Pb	0.5 - 1%	MS	W	0.1 - 2000	MS
Cu	0.5 - 2%	MS	Rb	0.05 - 2000	MS	Y	0.05 - 2000	MS
Fe	100 - 50%	MS	Re	0.002 - 2000	MS	Zn	1 - 2%	MS
Ga	0.05 - 2000	MS	S	500 - 10%	MS	Zr	0.1 - 2000	MS
Lithium 4 acid digestion		/MS				4A-Li/MS48		R508.34

Nickel Crucible Lithium Ore Grade Package

Element	Range ppm	Finish	Element	Range ppm	Finish	Element	Range ppm	Finish
Li	5 - 20%	OES	Fe	100 - 75%	OES	S	500 - 60%	OES
Al	100 - 50%	OES	K	500 - 20%	OES	Sn	2 - 50%	MS
B	50 - 10%	OES	Mg	100 - 60%	OES	Sr	20 - 20%	MS
Ba	1 - 2%	MS	Mn	0.2% - 75%	OES	Ta	0.1 - 50%	MS
Be	1 - 2%	MS	Nb	10 - 30%	MS	W	1 - 50%	MS
Ca	0.1% - 70%	OES	P	100 - 50%	OES			
Cs	0.1 - 1%	MS	Rb	0.5 - 5%	MS			
Sodium peroxide fusion Ni crucible		/MS, OES				FP6-Li/OM19		R520.63

Zirconium Crucible Fusion OES Individual Element

Element	Description	Range PPM	Code	Price
Li	Sodium peroxide fusion Zr Crucible	1 - 20%	FP1-Li/OE	R297.18

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	R424.55

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	COL01	R254.73

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	R847.98

Rare Earth Elements

Rare earth elements will play a significant role in the push towards net zero. The rare earth packages provided cover the 15 rare earth elements from Yttrium to Lutetium. The name rare earth is deceiving as they are relatively abundant in the earth's crust, however, they are generally dispersed and do not exist as concentrated ores, therefore correct analysis for your samples is imperative. Two fusion packages are offered for rare earth elemental analysis; a peroxide fusion and a borate fusion. These samples can be analysed via ICP-MS-QQQ for an interference free analysis of rare earths to achieve the low detection limits required for exploration samples. An XRF package is offered for precise quantification of the high concentration samples.

Ree Mineralisation NA Peroxide Fusion MS Package

Element	Range ppm	Finish	Element	Range ppm	Finish	Element	Range ppm	Finish
La	0.2 - 20%	MS	Ho	0.1 - 2%	MS	Ta	0.1 - 50%	MS
Ce	0.5 - 30%	MS	Er	0.1 - 5%	MS	Hf	0.1 - 5%	MS
Pr	0.1 - 10%	MS	Tm	0.1 - 1%	MS	Zr	5 - 50%	MS
Nd	0.1 - 20%	MS	Yb	0.1 - 5%	MS	Sn	2 - 50%	MS
Sm	0.1 - 10%	MS	Lu	0.1 - 1%	MS	W	1 - 50%	MS
Eu	0.1 - 5%	MS	Y	0.5 - 50%	MS	Li	1 - 20%	MS
Gd	0.1 - 5%	MS	Th	0.1 - 2%	MS	Be	1 - 2%	MS
Tb	0.1 - 2%	MS	U	0.1 - 60%	MS	Ga	1 - 5%	MS
Dy	0.1 - 5%	MS	Nb	10 - 30%	MS			
Sodium peroxide fusion Ni crucible			/MS			FP6/MS33		R578.73

Ree Mineralisation LI Borate Fusion MS Package

Element	Range ppm	Finish	Element	Range ppm	Finish	Element	Range ppm	Finish
La	0.2 - 20%	MS	Ho	0.1 - 2%	MS	Nb	0.1 - 5%	MS
Ce	0.5 - 30%	MS	Er	0.1 - 5%	MS	Ta	0.1 - 5%	MS
Pr	0.1 - 10%	MS	Tm	0.1 - 1%	MS	Hf	0.1 - 5%	MS
Nd	0.1 - 20%	MS	Yb	0.1 - 5%	MS	Zr	1 - 50%	MS
Sm	0.1 - 10%	MS	Lu	0.1 - 1%	MS	Sn	1 - 5%	MS
Eu	0.1 - 5%	MS	Y	0.5 - 50%	MS	W	1 - 5%	MS
Gd	0.1 - 5%	MS	Th	0.1 - 2%	MS	Ga	0.5 - 5%	MS
Tb	0.1 - 2%	MS	Be	0.5 - 2%	MS			
Dy	0.1 - 5%	MS	U	0.1 - 20%	MS			
Li borate fusion			/MS			FB6/MS34		R566.44

REE XRF Package

Element	Range ppm	Finish	Element	Range ppm	Finish	Element	Range ppm	Finish
La_2O_3	0.01 - 15	XRF	U_3O_8	0.01 - 3	XRF	Na_2O	0.01 - 100	XRF
CeO_2	0.01 - 30	XRF	ThO_2	0.01 - 3	XRF	P_2O_5	0.005 - 100	XRF
Pr_6O_{11}	0.01 - 5	XRF	Al_2O_3	0.01 - 100	XRF	SiO_2	0.01 - 100	XRF
Nd_2O_3	0.01 - 10	XRF	CaO	0.01 - 100	XRF	SO_3	0.005 - 5	XRF
Sm_2O_3	0.01 - 5	XRF	Fe_2O_3	0.01 - 100	XRF	TiO_2	0.01 - 100	XRF
Eu_2O_3	0.01 - 5	XRF	K_2O	0.01 - 100	XRF	LOI 1000°C	0.01 - 100	
Gd_2O_3	0.01 - 5	XRF	MgO	0.01 - 100	XRF			
Y_2O_3	0.01 - 5	XRF	MnO	0.01 - 100	XRF			
Li borate fusion			/XRF			FB1/XRF74		R847.98

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

Ionic Leach

Rare earth elements are often contained within minerals such as xenotime and monazite, which are difficult to break down and extract the elements of interest. Rare earth elements are also often bonded to clay. The concentration of rare earths in clays are often lower but are extracted much easier through an ion exchange method. The package offered here replicates the larger scale process with an ion exchange with ammonium sulphate and subsequent analysis via ICP-MS-QQQ.

Element	Range ppm			Finish	Element	Range ppm			Finish	Element	Range ppm			Finish
Ce	0.5	-	30%	MS	La	0.2	-	20%	MS	Tm	0.1	-	1%	MS
Dy	0.1	-	5%	MS	Lu	0.1	-	1%	MS	Y	0.5	-	50%	MS
Er	0.1	-	5%	MS	Nd	0.1	-	20%	MS	Yb	0.10	-	5%	MS
Eu	0.1	-	5%	MS	Pr	0.1	-	10%	MS	Sc	0.10	-	0.5%	MS
Gd	0.1	-	5%	MS	Sm	0.1	-	10%	MS					
Ho	0.1	-	2%	MS	Tb	0.1	-	2%	MS					

Ionic clay leach	/ICP first element	ICL/MS16	R491.58

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 characterisation 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 deportment of the metal in the ore. Total copper is offered by four acid digest. Umpire and commercial exchange assay services are available at Interteks specialist LSI laboratory, see Minerals Trade Services.

Specialised Copper Methods

Element	Description	Range	Code	Price
Cu	Aqua regia digest / ICP-OES	1 - 2%	Cu-AR1/OE	R140.77
Cu	4 acid digest / ICP-OES for more complete digestion of complex matrices	1 - 2%	Cu-4A/OE	R218.98
Cu	Ore grade 4 acid digest / ICP-OES	5 - 70%	Cu-4AO/OE	R241.32
Cu	Assay for commercial settlement (Intertek LSI)	-		POA
Cu	Multi acid digest / short iodide titration	-	Cu-VOL	R847.98
Cu Acid Soluble	Acid soluble copper (options available)	Various	Cu-AS/OE	R162.00
Cu CN Soluble	Cyanide soluble copper (options available)	Various	Cu-CN	R182.11
Cu Sequential	Acid soluble followed by cyanide soluble copper	Various	Cu-SQ	R565.32

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_2O_3	0.01	-	100	SiO_2	0.01	-	100
Al_2O_3	0.01	-	100	K_2O	0.01	-	100	SO_3	0.002	-	15
BaO	0.01	-	10	MgO	0.01	-	100	TiO_2	0.01	-	100
CaO	0.01	-	100	Na_2O	0.01	-	100	V_2O_5	0.005	-	10
Cr_2O_3	0.005	-	100	P_2O_5	0.002	-	100	LOI 1000°C	0.01	-	100
Cu	0.005	-	5	Pb	0.005	-	5				

Li borate fusion / XRF	FB1/XRF25	R635.70
Zn as an additional element	FB1/XRF25-1	R669.22

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

Graphites

Important commodities in the battery and energy sector are not exclusively metals. Graphite is a critical component in lithium-ion batteries, acting as the anode. Intertek offers packages suitable for graphite analysis with a straight analysis for total carbon and an acid digest followed by analysis for non-carbonate carbon and graphitic carbon.

Element	Description	Detection Limit	Code	Price
C	Total carbon by CS analyser	0.01% - 50%	CSA01	R217.30
C non-carbonate	Weak acid digestion / CS analyser 0.01%	0.01% - 50%	C71/CSA	R395.50
C graphitic	Weak acid digestion, 420°C roast / CS analyser	0.1% - 40%	C73/CSA	R452.48
C graphitic (high-range)	Weak acid digestion, 420°C roast / CS analyser	40% - 100%	C75/CSA	R565.32

Uranium

Uranium is a metallic, radioactive element which has some affinities with REE, Th, Y, Zr Mo, Ba and Ca. It occurs in a variety of primary and secondary minerals such as oxides (uraninite, pitchblende), titanates (davidite, brannerite, absite), niobates (euxenite, fergusonite, samarskite), phosphates (torbernite, autunite, saleeite), vanadates (carnotite), silicates (coffinite, uranophane, sklodowskite), as well as carbonates, sulphates, selenites, tellurites, hydroxides, halides, arsenates, molybdates and nitrates. Most exploration programs exploit the radioactive properties of U with radiometric surveys the first step in a U exploration program, however, be aware of the limitation of such surveys. Intertek offers a wide range of analysis techniques that can be used in conjunction with the radiological surveys for the quantification of U in your samples. The package offered below is designed for the low detection limit analysis suitable for exploration samples.

Uranium Four Acid Exploration OES & MS Package

Element	Range ppm	Finish	Element	Range ppm	Finish	Element	Range ppm	Finish
As	0.5 - 1%	MS	K	20 - 10%	OES	Se	0.5 - 1%	MS
Bi	0.01 - 1%	MS	La	0.01 - 5000	MS	Th	0.01 - 5000	MS
Ca	50 - 40%	OES	Mo	0.1 - 1%	MS	U	0.01 - 1%	MS
Co	0.1 - 2%	MS	Ni	0.5 - 5%	OES	V	1 - 2%	OES
Cu	0.5 - 5%	OES	Pb	0.5 - 1%	MS			
Fe	100 - 50%	OES	S	50 - 5%	OES			
4 acid digest			/OES & MS			4A/OM47		R438.51

Uranium Four Acid Ore Grade OES & MS Package

Element	Range ppm	Finish	Element	Range ppm	Finish	Element	Range ppm	Finish
As	10 - 20%	MS	K	200 - 20%	OES	Se	10 - 2%	MS
Bi	0.1 - 10%	MS	La	0.5 - 2%	MS	Th	0.5 - 1%	MS
Ca	100 - 50%	OES	Mo	1 - 10%	MS	U	0.5 - 30%	MS
Co	10 - 20%	MS	Ni	10 - 70%	OES	V	20 - 5%	OES
Cu	10 - 70%	OES	Pb	10 - 70%	MS			
Fe	100 - 70%	OES	S	100 - 5%	OES			
U ore grade package 4 acid digest			/OES & MS			4AH/OM47		R473.71

Uranium Nickel Crucible Fusion MS Package

Element	Description	Range PPM	Code	Price
U	Na peroxide fusion / MS	0.1 - 60%	FP6/MS45	R353.04

Uranium Lithium Borate Ore Grade MS Package

Element	Description	Range PPM	Code	Price
U	Lithium borate fusion / MS	0.1 - 30%	FB6/MS45	R353.04

Uranium Ore Grade XRF Package

Element	Description	Range %	Code	Price
U	Lithium borate fusion / MS	0.002 - 10	FB1/XRF45	R635.70

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.

The most commonly used analytical procedures are listed, however this is not an exhaustive list and we encourage you to contact your local manager to discuss your specific requirements. Not all methods and packages listed are available at all locations.

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 54.

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.

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	-	40%	Zr	5	-	2000

Ore grade 4 acid digest / ICP-OES first element	4AO/OM	R241.32
/ per additional element		R14.52

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 37.

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 page 44 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 39 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_2O_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_2O	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_2O	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_2O_5	0.01%	-	100%	ICP-OES	V	10	-	5%	ICP-OES
Fe_2O_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	R353.04
/ secondary instrument first element		R140.77
/ per additional element		R16.76
Lithium borate fusion 45 element package	FB6/OM45	R850.21

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

Sodium peroxide fusion Zr crucible	/ ICP first element	FP1/OM	R297.18
	/ secondary instrument first element		R112.84
	/ per additional element		R16.76
Sodium peroxide fusion Zr crucible 42 element package		FP1/OM42	R809.99

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
Cr	500 - 40%	ICP-OES	P	100 - 50%	ICP-OES	Tl	0.5 - 2%	ICP-MS
Cs	0.1 - 1%	ICP-MS	Pb	20 - 70%	ICP-MS	Tm	0.1 - 1%	ICP-MS
Dy	0.1 - 5%	ICP-MS	Pr	0.1 - 10%	ICP-MS	U	0.1 - 60%	ICP-MS
Er	0.1 - 5%	ICP-MS	Rb	0.5 - 5%	ICP-MS	V	50 - 20%	ICP-OES
Eu	0.1 - 5%	ICP-MS	Re	0.1 - 1%	ICP-MS	W	1 - 50%	ICP-MS
Fe	100 - 75%	ICP-OES	S	500 - 60%	ICP-OES	Y	0.5 - 50%	ICP-MS
Ga	1 - 5%	ICP-MS	Sb	0.5 - 10%	ICP-MS	Yb	0.1 - 5%	ICP-MS
Gd	0.1 - 5%	ICP-MS	Sc	10 - 5%	ICP-OES	Zr	5 - 50%	ICP-MS
Hf	0.1 - 5%	ICP-MS						

Sodium peroxide fusion Ni crucible	/ ICP first element	FP6/OM	R353.04
	/ secondary instrument first element		R140.77
	/ per additional element		R16.76
Sodium peroxide fusion Ni crucible package 55 element package		FP6/OM55	R1036.79

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_2O_3	0.01	-	100	MnO	0.01	-	100	TiO_2	0.01	-	100
CaO	0.01	-	100	Na_2O	0.01	-	100	V_2O_5	0.005	-	10
Cr_2O_3	0.005	-	10	P	0.001	-	45	LOI 1000°C	0.01	-	100
K_2O	0.01	-	100	S	0.001	-	5				

Li borate fusion / XRF	FB1/XRF10	R497.17
Multiple point LOI per additional temperature point	FB1/XRF10-1	R34.63

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_2O	0.01	-	100	Sn	0.005	-	5
Al_2O_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_2O	0.01	-	100	V_2O_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_2O_3	0.005	-	10	S	0.001	-	5				
Cu	0.005	-	5	SiO_2	0.01	-	100				

Li borate fusion / XRF	FB1/XRF11	R564.20
Multiple point LOI per additional temperature point	FB1/XRF11-1	R34.63

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_2O	0.01	-	100	Sn	0.001	-	5
Al_2O_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_2O	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	-	5				
Cu	0.001	-	5	SiO_2	0.01	-	100				

Li borate fusion / XRF	FB1/XRF12	R636.82
Multiple point LOI per additional temperature point	FB1/XRF12-1	R34.63

Multi-point LOI values are cumulative unless requested otherwise.

Additional methods

Element	Description	DL	Code	Price
FeO	Acid digestion / titration	0.1%	AD71/VOL	R565.32

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_2O_3	0.01	-	100	MgO	0.01	-	100	TiO_2	0.01	-	100
BaO	0.01	-	5	MnO	0.01	-	100	V_2O_5	0.005	-	10
CaO	0.01	-	100	Na_2O	0.01	-	100	ZrO_2	0.01	-	5
Cr_2O_3	0.005	-	10	P_2O_5	0.002	-	100	LOI 1000°C	0.01	-	100
Fe_2O_3	0.01	-	100	SiO_2	0.01	-	100				
K_2O	0.01	-	100	SO_3	0.002	-	15				

Li borate fusion / XRF	FB1/XRF30	R489.35
Ga as an additional element	FB1/XRF30-1	R522.86

Bayer Leach Procedures

Element	Description	DL	Code	Price
AAl_2O_3, $RxSiO_2$	Hydroxide leach @ 145°C / ICP-OES*	0.10%	BX1/OE	R478.17
$Na_2C_2O_4$, Na_2SO_4	Oxalates and sulphates by Ion Chromatography	0.01%	BX1/IC	R539.66

* Optional temperatures are available on request.

Bayer Leach Package

Element	Description	DL	Code	Price
AAl_2O_3, $RxSiO_2$	Hydroxide leach @ 145°C / ICP-OES*	0.10%	BX1/202	R763.07
$Na_2C_2O_4$, Na_2SO_4	Oxalates and sulphates as additional elements by Ion Chromatography	0.01%		

* Optional temperatures are available on request.

Chromium 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_2O_3	0.005	-	100	MgO	0.01	-	100	SO_3	0.002	-	15
Al_2O_3	0.01	-	100	MnO	0.01	-	100	TiO_2	0.01	-	100
CaO	0.01	-	100	Na_2O	0.01	-	100	V_2O_5	0.005	-	10
Fe_2O_3	0.01	-	100	P_2O_5	0.002	-	100	LOI 1000°C	0.01	-	100
K_2O	0.01	-	100	SiO_2	0.01	-	100				

Li borate fusion / XRF	FB1/XRF35	R777.59

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_2O_3	0.01	-	100	Sc	0.004	-	5
Co	0.005	-	5	K_2O	0.01	-	100	SiO_2	0.01	-	100
Al_2O_3	0.01	-	100	MgO	0.01	-	100	SO_3	0.002	-	15
CaO	0.01	-	100	MnO	0.01	-	100	TiO_2	0.01	-	100
Cu	0.005	-	5	Na_2O	0.01	-	100	Zn	0.005	-	5
Cr_2O_3	0.005	-	10	P_2O_5	0.002	-	100	LOI 1000°C	0.01	-	100

Li borate fusion / XRF	FB1/XRF40	R530.68

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 & Gypsum

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

Element	Range %			Element	Range %			Element	Range %		
Al_2O_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_2O_3	0.01	-	100	Na_2O	0.01	-	100	LOI 1000°C	0.01	-	100
Fe_2O_3	0.01	-	100	P_2O_5	0.002	-	100				
K_2O	0.01	-	100	SiO_2	0.01	-	100				

Clay minerals package Li borate fusion / XRF	FB1/XRF50	R494.93
Limestone & dolomites Li borate fusion / XRF	FB1/XRF60	R494.93
Gypsum package Li borate / XRF	FB1/XRF61	R494.93

* Note drying of Gypsum at 40°c

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

Phosphates & Potash

Fusion XRF Packages

Element	Range %			Element	Range %			Element	Range %		
Al_2O_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_2O_3	0.01	-	10	Na_2O	0.01	-	100	LOI 1000°C	0.01	-	100
Fe_2O_3	0.01	-	100	P_2O_5	0.002	-	100				
K_2O	0.01	-	100	SiO_2	0.01	-	100				

Phosphate majors package	FB1/XRF55	R494.93
Marine phosphorite and glauconite	FB1/XRF56	R494.93

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	R391.03

Additional Elements

Element	Description	DL	Code	Price
Hg	Controlled temperature acid digest / ICP-MS	1ppb	AR005-Hg/MS	R220.09
F	Carbonate fusion / SIE	50ppm	FC7/SIE	R451.36

Complete Phosphate Package

Element	Description	Code	Price
Majors: Al_2O_3, CaO, Cr_2O_3, Fe_2O_3, K_2O, MgO, MnO, Na_2O, P_2O_5, SiO_2, SO_3, TiO_2, LOI	Li borate fusion / XRF	P/201	R1485.92
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_2O	0.01	-	100	SiO_2	0.01	-	100
WO_3	0.01	-	10	MgO	0.01	-	100	SO_3	0.005	-	5
Al_2O_3	0.01	-	100	MnO	0.01	-	100	TiO_2	0.01	-	100
CaO	0.01	-	100	Na_2O	0.01	-	100	LOI 1000°C	0.01	-	100
Fe_2O_3	0.01	-	100	P_2O_5	0.005	-	100				

Cassiterite Package Li borate fusion / XRF	FB1/XRF70	R707.21

Mineral Sand - Zircon XRF Package

Element	Range %			Element	Range %			Element	Range %		
ZrO_2	0.01	-	70	K_2O	0.01	-	100	SiO_2	0.01	-	100
HfO_2	0.005	-	2	MgO	0.01	-	100	SO_3	0.002	-	5
Al_2O_3	0.01	-	100	MnO	0.01	-	100	TiO_2	0.01	-	100
CaO	0.01	-	100	Na_2O	0.01	-	100	V_2O_5	0.005	-	5
Fe_2O_3	0.01	-	100	P_2O_5	0.002	-	100	LOI 1000°C	0.01	-	100

Mineral Sand - Zircon Package Li borate fusion / XRF	FB1/XRF71	R707.21

Mineral Sand - Rutile/Ilmenite XRF Package

Element	Range %			Element	Range %			Element	Range %		
TiO_2	0.01	-	100	Fe_2O_3	0.01	-	100	P_2O_5	0.002	-	100
V_2O_5	0.005	-	5	K_2O	0.01	-	100	SiO_2	0.01	-	100
Al_2O_3	0.01	-	100	MgO	0.01	-	100	SO_3	0.002	-	5
CaO	0.01	-	100	MnO	0.01	-	100	ZrO_2	0.005	-	5
Cr_2O_3	0.005	-	5	Na_2O	0.01	-	100	LOI 1000°C	0.01	-	100

Mineral Sand - Rutile Package Li borate fusion / XRF	FB1/XRF72	R707.21
- Ilmenite Package Li borate fusion / XRF	FB1/XRF77	R707.21

Tantalites XRF Package

Element	Range %			Element	Range %			Element	Range %		
Ta_2O_5	0.01	-	45	Fe_2O_3	0.01	-	100	SiO_2	0.01	-	100
Nb_2O_5	0.01	-	25	K_2O	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_2O_3	0.01	-	100	Na_2O	0.01	-	100				
CaO	0.01	-	100	P_2O_5	0.005	-	100				

Tantalites Package Li borate fusion / XRF	FB1/XRF73	R778.71

Tungsten Ores XRF Package

Element	Range %			Element	Range %			Element	Range %		
WO_3	0.01	-	80	K_2O	0.01	-	100	SiO_2	0.001	-	100
MoO_3	0.01	-	5	MgO	0.01	-	100	SnO_2	0.01	-	10
Al_2O_3	0.01	-	100	MnO	0.01	-	100	SO_3	0.005	-	5
CaO	0.01	-	100	Na_2O	0.01	-	100	TiO_2	0.01	-	100
Fe_2O_3	0.01	-	100	P_2O_5	0.005	-	100	LOI 1000°C	0.01	-	100

Tungsten Ore Package Li borate fusion / XRF	FB1/XRF75	R778.71

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

Lithogeochemistry & Whole Rock Analyses

Lithogeochemistry

Lithogeochemical analyses involve the comprehensive chemical characterisation 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. Lithogeochemical 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.

The most commonly used analytical procedures are listed, however this is not an exhaustive list and we encourage you to contact your local manager to discuss your specific requirements. Not all methods and packages listed are available at all locations.

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.

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

ELEMENT	DESCRIPTION	CODE	PRICE
Whole rock: SiO_2, TiO_2, Al_2O_3, Fe_2O_3, MnO, MgO, CaO, Na_2O, K_2O, P_2O_5, Ba, Cr, S, LOI	Lithium borate fusion ICP-OES & ICP-MS	LITH/203	R1187.62
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 lithogeochemical 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_2O_3, Fe_2O_3, MnO, MgO, CaO, Na_2O, K_2O, P_2O_5, BaO, Cr_2O_3, SO_3, LOI	Lithium borate fusion XRF (or ICP-OES)	LITH/204X (LITH/2040E)	R2006.55 (R1852.37)
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		
C, S	CS Analyser		
Au, Pt, Pd as additional elements	Fire Assay/ ICP-MS	LITH/205X (LITH/2050E)	R2304.85 (R2148.43)
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_2O_3	0.01	-	10
Al_2O_3	0.01	-	100	Na_2O	0.01	-	100	SO_3	0.01	-	100
Fe_2O_3	0.01	-	100	K_2O	0.01	-	100	LOI 1000°C	0.01	-	100
MnO	0.01	-	100	P_2O_5	0.002	-	100				

Whole rock	Li borate fusion / XRF	FB1/XRF20	R565.32

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_2O_3	0.01	-	100	Na_2O	0.01	-	100	S	0.01	-	30
Fe_2O_3	0.01	-	100	K_2O	0.01	-	100	LOI 1000°C	0.01	-	100
MnO	0.01	-	100	P_2O_5	0.01	-	100				

Whole rock	Li borate fusion / ICP-OES	FB6/OE01	R565.32

Rare Earth Element (REE) Fusion ICP-MS Package

Element	Range %			Element	Range %			Element	Range %		
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	R565.32
REE add on	ICP-MS package as add ons		POA

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

Element	Range %			Element	Range %			Element	Range %		
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-MS	FB6/MS63	R418.96
HFSE add on	ICP-MS package as add ons		POA

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

Element	Range %			Element	Range %			Element	Range %		
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	R593.25
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 %			Element	Range %			Element	Range %		
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	R367.57

Additional Analysis

Carbon and Sulphur Analysis

Element	Description	Detection Limit	Code	Price
C,S	Total carbon & sulphur by CS analyser	0.01%- 50%	CSA03	R326.23

Platinum Group Elements by Fire Assay ICP-MS

Element	Description	Detection Limit	Code	Price
Au, Pt, Pd	Fire assay / ICP MS	1ppb, 0.5ppb, 0.5ppb	FA25/MS	R290.48

Nickel Sulphide Collection Fire Assay

Element	Description	Detection Limit	Code	Price
Au	25g NiS fire assay low level / ICP-MS	2ppb - 500ppb	NS25L/MS	R2066.88
Pt, Pd, Rh, Ru, Ir, Os		1ppb - 500ppb		
Au	25g NiS fire assay ore grade / ICP-MS	5ppb - 100ppm	NS25H/MS	R2066.88
Pt, Pd, Rh, Ru, Ir, Os				

Mercury Analysis

Element	Description	Detection Limit	Code	Price
Hg	Acid digest / ICP MS	1ppb	AR005-Hg/MS	R220.09

Fluoride Analysis by Selective Ion Electrode

Element	Description	Detection Limit	Code	Price
F	Carbonate fusion / SIE	50ppm	FC7/SIE	R451.36

Ferrous Iron

Element	Description	Detection Limit	Code	Price
FeO	Acid digestion / titration	0.1%	AD71/VOL	R565.32

Choride

Element	Description	Detection Limit	Code	Price
Cl*	Carbonate leach / colorimetry	0.02%	CL1/COL	R456.95

*Suitable for concentrates only

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	R380.98
	Additional element			R16.76
Barium in barite	EDTA extraction / ICP-OES	2ppm	EDTA/OE	R373.15
Cl*	Carbonate leach / colorimetry	0.02%	CL1/COL	R456.95
F	Carbonate fusion / SIE	50ppm	FC7/SIE	R451.36
F	Alkaline fusion	200ppm	FC8/SIE	R539.62
Hg	Acid digest / ICP-MS	1ppb	AR005-Hg/MS	R220.09
Se	Precipitation/ ICP-MS	0.01ppm	SE1/MS	R452.48
FeO	Acid digestion / titration	0.1%	AD71/VOL	R565.32

*Suitable for concentrates only

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	R217.30
S	Total sulphur by CS analyser	0.01% - 50%	CSA02	R217.30
C,S	Total carbon & sulphur by CS analyser	0.01% - 50%	CSA03	R326.23
C non-carbonate	Weak acid digestion / CS analyser	0.01% - 50%	C71/CSA	R395.50-
C graphitic	Weak acid digestion, 420°C roast / CS analyser	0.1% - 40%	C73/CSA	R452.48
C graphitic (high range)	Weak acid digestion, 420°C roast / CS analyser	40% - 99%	C75/CSA	R565.32
S-SO_4*	HCl digest for soluble sulphates / ICP-OES	0.01% - 50%	S71/OE	R277.07
S-SO_4*	Carbonate extract for soluble sulphate /gravimetric	0.01% - 50%	S72/GR	R526.22

*May not include all Ba, Sr and Pb sulphates

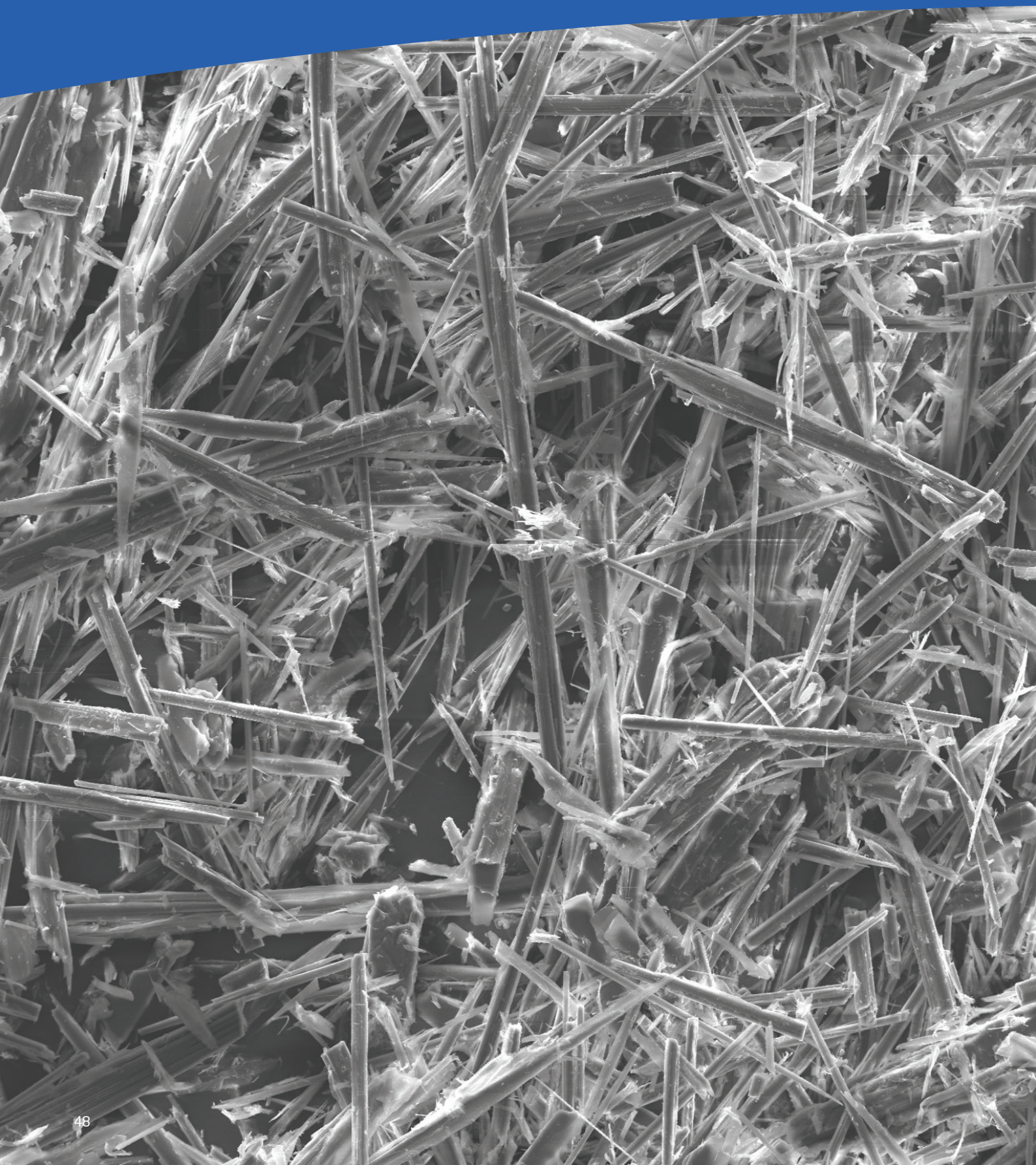
Acid Rock Drainage Package

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	1kgH_2SO_4/t	ARD01	R1073.66
NAG	Titrimetric measurement of acid generation by oxidation	1kgH_2SO_4/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	1kgH_2SO_4/t		
MPA	Maximum potential acidity calculated from S	1kgH_2SO_4/t		

The most commonly used analytical procedures are listed, however this is not an exhaustive list and we encourage you to contact your local manager to discuss your specific requirements. Not all methods and packages listed are available at all locations.

Mineralogy



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, however not all services are available at all locations. 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 < 60µm	XRD13	R285.56

*Samples are not to be dried

XRD Crush, Pulverize and Micronize Package

Description	Code	Price
Crush -2mm, rotary split 800g, pulverise 800g to <60µm, micronise	XRD15	R469.24

*Samples are not to be dried

XRD Crush, Pulverize and Micronize Package

Description	Code	Price
Pulverise <800g to < 60µm, micronise	XRD16	R368.69

*Samples are not to be dried

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	R2346.18
QUANTITATIVE	Quantitative analysis for complete mineralogy and amorphous content	XRDQuant01	R3472.35

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)

XRD Clay separation

Description	Code	Price
Separation of clay fraction, <2 µm	CLAYF	R938.47
Separation of clay fraction, <2 µm, in iron-rich samples	CLAYFFe	R1608.81

X-Ray Diffraction Analysis

Description	Code	Price	Price
QUALITATIVE	Qualitative analysis of clays (incl. glycolation and heating)	XRDQual01	R5362.70

Infra-Red Spectroscopy

TerraSpec Near-Infrared Spectroscopy (NIR)

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.

ASD Terraspec Scan

Description	Code	Price
TerraSpec 4 Hi Res scan	NIR	POA
TSG Post processing mineralogy report - standard report (includes scan)	NIR01	POA
aiSIRIS™ Post processing mineralogy report - standard report (includes scan)	NIR03	POA

Fourier-Transform Infrared Spectroscopy (FTIR)

Fourier-Transform Infrared Spectroscopy (FTIR) offers a rapid scan technique for the qualitative and quantitative analysis of organic and inorganic materials and minerals. Regression and calibration methods enable quantitative determination of mineralogy. This non-destructive technique requires minimal sample preparation.

Description	Code	Price
FTIR Scan	FTIR	POA
Quantitative determination	FTIR02	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 visualisation 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.

Additional 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 emailed.

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 11)
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 Minerals 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.

Interstate Importation of Samples into Western Australia

Intertek Minerals' Perth laboratory is also a Quarantine Western Australian approved premise for the clearance, reception and treatment of samples from interstate which are subject to quarantine.

When importing mineral samples interstate from within Australia the following document requirements should be followed:

- Importation of samples that have been obtained from a depth greater than two meters that are clean and free of surface and plant related material can be imported interstate within Australia without requiring quarantine treatment. Goods must be accompanied by a manufacturers declaration only.
- Importation of all soil related material which is classified as 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 121°C for a minimum of two hours. Goods must be accompanied by a manufacturers declaration.

Detailed information and document requirements on how the successfully import mineral samples interstate within Australia can be obtained through our website or by contacting the Perth Office. A nominal fee is charged for quarantine treatment.

Please note that the Quarantine heat treatment temperature is 121°C for interstate samples only.

Service Fees and Surcharges

Prices in this schedule are effective from 1st May 2023.

Intertek Minerals does not charge an administration or batch fee for routine geochem suite, however there is a minimum invoice charge of R4357.20 for routine geochemistry and R5195.12 for all other work. The batch fee will be applied for non-routine geochem.

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.

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 South African Rand, and exclude VAT.

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.

Value Added Services

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, significantly improving safety.

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.

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.

Mine and Port Site Laboratories

Intertek operates, designs and commissions dedicated mine site laboratories in remote locations to enhance its service to mining operations across multiple mineral commodities. Intertek provides clients with a complete solution for any scale of mine or port site laboratory installation, from concept phase to commissioning and ongoing management and operation.

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 globally.

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.

Mineralogy

Intertek's leading expertise and state-of-the-art facilities offer a range of mineralogical services. Technical specialists in XRF and XRD support local and global operations, producing quality reliable data with the reassurance of years of experience from onsite XRD specialists and instrumentation.

- Research quality lithogeochemical packages
- Applied bulk mineralogy
- Low cost XRF & spectral scanning
- TerraSpec Near-Infrared Spectroscopy
- FTIR Spectroscopy
- Applied Micro Mineralogy QEMSCAN

Minerals Environmental Testing Services

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

- Water quality
- Sediment and soil analysis
- Acid sulphate soils
- Biological tissue analysis
- Waste analysis and characterisation
- Acid rock drainage prediction test
- Soil nutrient analysis

Total Sustainability. Assured.

Intertek is uniquely positioned to partner with our clients and meet their needs by delivering a wide variety of sustainability services that help them to manage risk and resilience with increased transparency and confidence, whilst supporting their ability to operate effectively and act responsibly. Intertek's Total Sustainability Assurance is a pioneering initiative that provides an end-to-end independent, systematic sustainability programme from both an operational and corporate perspective.

Intertek's Corporate Sustainability Certification programme, powered by our technical expertise and advanced software platforms, can help your organisation to authentically demonstrate and independently verify its commitment to sustainability across the entire value chain, building stakeholder trust and corporate value. Total Corporate Sustainability Certification is comprised of 10 comprehensive standards, aligned with the UN Sustainable Development Goals, that provide holistic quality, safety and sustainability assurance of operations, services and products, whilst fostering a culture of sustainability through awareness, training and engagement.

TOTAL SUSTAINABILITY. ASSURED.

Production Services

Intertek's analytical and scientific services are focused on extending the longevity of plant and equipment and optimising operations.

- Oil Condition Monitoring
- Pipeline inspection and testing
- Refinery Representation and Superintending
- Fuel tank inspection and testing
- Tank/pump inspection and calibration
- Environmental 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.

Industry Services

ntertek'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.

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

Conversion Tables

Useful Chemical Conversion Factors

Element		Factor	Compound	Element		Factor	Compound	Element		Factor	Compound
Al	x	1.889	Al_2O_3	Fe	x	1.43	Fe_2O_3	Pb	x	1.155	PbS
As	x	1.32	As_2O_3	Fe	x	1.574	FeS	Rb	x	1.094	Rb_2O
B	x	3.22	B_2O_3	K	x	1.205	K_2O	Sb	x	1.197	Sb_2O_3
Ba	x	1.699	$BaSO_4$	La	x	1.173	La_2O_3	Si	x	2.139	SiO_2
Ba	x	1.117	BaO	Li	x	2.153	Li_2O	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_2O_5
Ca	x	2.497	$CaCO_3$	Mn	x	1.291	MnO	Th	x	1.138	ThO_2
Ce	x	1.171	Ce_2O_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_3O_8
Cr	x	1.462	Cr_2O_3	Mo	x	1.668	MoS_2	V	x	1.785	V_2O_5
Cs	x	1.06	Cs_2O	Na	x	1.348	Na_2O	W	x	1.261	WO_3
Cu	x	1.252	CuO	Nb	x	1.432	Nb_2O_5	Y	x	1.27	Y_2O_3
Cu	x	1.252	Cu_2S	Ni	x	1.273	NiO	Zn	x	1.245	ZnO
F	x	2.055	CaF2	P	x	2.291	P_2O_5	Zn	x	1.49	ZnS
Fe	x	1.287	FeO	Pb	x	1.077	PbO	Zr	x	1.351	ZrO_2

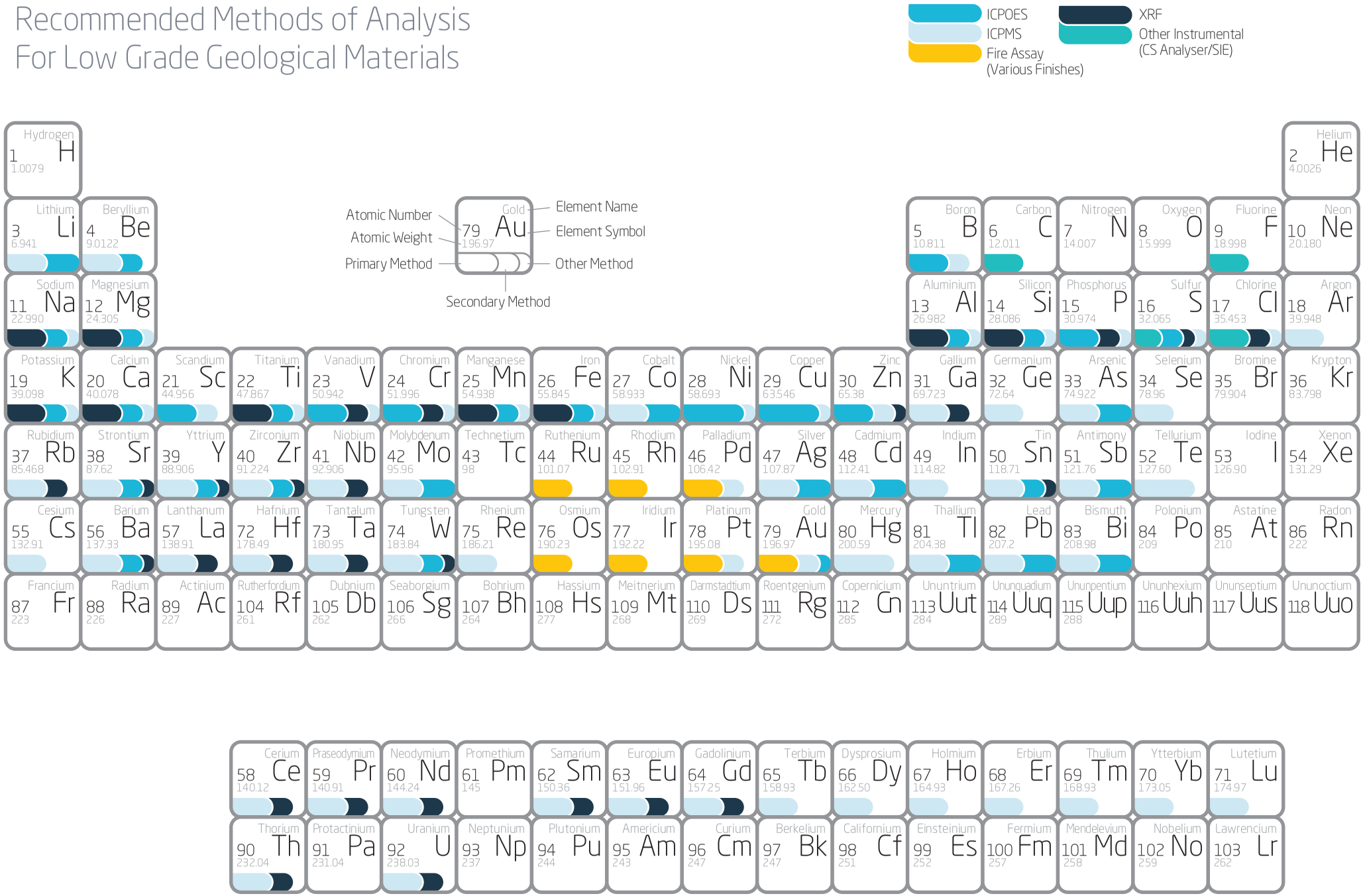
Common Equivalents

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 (CM3)		
		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



Intertek Minerals Services Terms and Conditions (2023)

1.0 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, Intertek Genalysis South Africa 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 LSI, Laboratory Services International Rotterdam B.V.

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.

8.3 Upon payment of the total sum due to the Company by the Principal, the Principal shall have a perpetual, irrevocable, fully paid up and royalty free licence to use the final report or certificate. The Company shall own all analysis, data and intellectual property generated pursuant to the creation of the report or certificate.

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 Principal. The Company shall not be liable for any claim whatsoever relating to deterioration, contamination, damage or loss of samples. The Principal 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 agreed in writing.

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%) per month 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, or failure by the Principal to meet payment obligations in this clause 16 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 Minerals
Perth Minerals Head Office and Laboratory
544 Bickley Road, Maddington, Western Australia 6109
Tel: +61 8 9263 0100 | Email: min.aus.per@intertek.com
Sample Deliveries: 311 Kenwick Road, 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, East Arm, Northern Territory 0822
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
Tel: +86 1509916 7729 | Email: hongchang.wang@intertek.com

Qingdao Inspection and Sample Preparation Facility
Tel: +86 13805326726 | Email: stephen.liu@intertek.com

Ningde Inspection and Sample Prepration Facility
Tel: +86 13503064504 | Email: frankie.fan@intertek.com

Zhanjiang Inspection and Sample Prepration Facility
Tel: +86 13503064504 | Email: ice.liu@intertek.com

Guangzhou Coal Laboratory
Tel: +86 2028206006 | Email: david.chen@intertek.com

Lianyungang Office and Inspection
Tel: +86 15062910451 | Email: henry.hu@intertek.com

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

Medan (North Sumatera) Sample Preparation Facility
Tel: +62 61 7781 4546 | Email: min.idn.jkt@intertek.com

Sumbawa (West Nusa Tenggara) Sample Preparation Facility
Tel: +62 811 8498 709 | 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 8498 710 | Email: min.idn.jkt@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

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

USA

Chicago Coal Laboratory
Tel: +1 815 221 5002 | Email: cbwchicargo@intertek.com

Detroit Zug Island Coal Laboratory
Tel: +1 313 849 5527 | Emaill: zuglslandlab@intertek.com

New Orleans NOLA Coal Sample Preparation Facility
Tel: +1 504 602 2100 | Email: mineralsUSA@intertek.com

Shenango Pittsburgh Coal Laboratory
Tel: +1 412 771 0973 | Email: nevlllelslandlab@intertek.com

St Louis Coal Sample Preparation Facility
Tel: +1 314 869 7878 | Email: mineralsUSA@intertek.com

Europe, the Middle East and Africa

Eritrea

Adi Guadad, Eritrea Sample Preparation Facility
Tel: +291 7 290 945 | Email: min.eri.asm@intertek.com

Ghana

Tarkwa Laboratory
Tel: +233 (0)312 320 386 | Email: min.gha.tkw@intertek.com

Netherlands

LSI Rotterdam Laboratory
Tel: +31 10 495 48 09 | Email: info@lsi-assays.com

South Africa

Johannesburg Laboratory
Tel: +27 11 964 1004 | Email: min.zaf.jhb@intertek.com

Zambia

Chingola Sample Preparation Facility
Tel +260 212 310 680 I Email: min.zam.cgj@Intertek com

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

Notes

Notes

intertek.com

intertek
minerals