SCHEDULE OF ANALYTICAL SERVICES & FEES



AUSTRALIA



THE EXPERTS IN SPECTRAL TECHNOLOGY

Portable Spectral Services (PSS) is an **industry leader** in the application of spectral technologyfor chemical analysis, mineral identification and geometallurgy applications. We offer a suite of **spectral and field-based testing technologies** that enable a **short lead-time** on results to facilitate timely operational decisions.

Visit us at www.portaspecs.com

SEE MORE KNOW MORE

Portable Spectral Services has collaborated with Geochemical Services Pty Ltd to create two comprehensive **educational resource websites.**





Benefits include:

- Infield mineral identification
- Portable, small, light weight, rugged design
- No sample preparation required
- Non-destructive mineral identification
- Samples do not have to be dry
- Fast analysis times from 10 seconds to over a minute



GOING GREEN

Chemistry without Chemicals

Portable Spectral Services is the first company worldwide to offer **chemical free**, **non-destructive & environmentally friendly analytical services**. Developed through an extensive Research and Development program, we produce quality, reliable data, with the assurance of years of experience and a proven track record.

We deliver bespoke and 'off the shelf' analysis to provide **innovative solutions** for our local & global clients and industry partners.

Portable Spectral Services facilitates successful scientific analyses for local to global businesses. We pride ourselves on environmental sustainability, performance and integrity in providing a **chemical-free solution** to analysis.



SAMPLE INTEGRITY IS OUR TOP PRIORITY.

With our spectral analytical techniques we ensure that the sample scanning process is **non-destructive**, with the added benefit of **minimal sample preparation**.

Non-destructive scanning enables multiple spectral technologies to be applied to the samples when required. You provide the samples, we do the rest!

CONTENTS

SAMPLE SUBMISSION	
Optimal Sample Types for Spectral Method	7
Sample Submission Sample Submission Powders, Sediments, Soils Preparation Package Micro-XRF Preparation Package Miscellaneous Procedures	8 9 9 9
PORTABLE XRF ANALYSIS	
Portable XRF Analysis Powers, Pulps, Soils & Sediment	11
pXRF & Oils Portable XRF Fuel Oil (including MARPOL) Industrial Minerals	12
Powers, Pulps, Soils & Sediment	12
Powers, Pulps, Soils & Sediment Useful Chemical Conversion Factors	13 13
SPECTRAL MINERALOGY	
Infrared Spectroscopy	15
Fourier Transform Infrared Spectroscopy (FTIR) <i>FTIR Services</i> <i>ATR-FTIR: Example of Minerals & Limits</i> Raman Spectroscopy	16 17 18
MICRO CHEMISTRY & MINERALOGY	
Micro-XRF Element and Mineral Mapping	20
Advanced Mineral Identification & Characterisation System Automated Mineralogy via AMICS	21
SPECIFIC EXPLORATION, ORES & COMMODITIES PACK	AGES
Gold	23
Lithium & LCT Pegmatites	24
Regolith Hosted Deposits	25
Nickel Sulphides	26



Portable Spectral Services reserves the right to alter listed prices at any time.

29

30

31



SAMPLE SUBMISSION

For each spectral method, the optimal sample type varies. This provides the flexibility and opportunity to acquire decision making analysis rapidly and early in the analytical cycle without requiring full laboratory sample preparation.

OPTIMAL SAMPLE TYPES FOR SPECTRAL METHOD

To maximise value, we recommend the following sample types **SPECTRAL METHOD** ABBREVIATION POWDERS CHIPS **CORE/SLAB** Portable X-Ray Fluorescence pXRF *** ** * Fourier-Transform Infrared **FTIR** *** * ** Spectroscopy Shortwave Infrared SWIR *** *** ** Raman Spectroscopy pRAM * ** *** Micro X-ray Fluorescence μXRF ** *** *

*** Best Value ** Some Value * Poor Value

SAMPLE SUBMISSION

We encourage our clients to ensure their sample submissions are:

- Clearly labeled
- Well packaged
- In a sequential order
- In a form that allows for optimal analysis (e.g., dry, pulverised)

Please ensure written instructions and freight information are supplied via email to info@portaspecs.com or accompany the samples on delivery.*

Prior to, or at the time of receipt, a sample submission form is required as part of our sample chain of custody procedure.

Adhering to our sample submission procedure will allow efficient processing and commencement of analysis.

* Sample submissions that are poorly labeled, packaged or provided in non-sequential manner may incur additional sorting charges and delayed analysis timeline.



SAMPLE SUBMISSION

CODE	DESCRIPTION	APPLICATION	PRICE
FRHT - 01	Freight expenses incurred	Sending samples from facility	At cost
PICK - 01	Sample pick up and transport	Client pick-up	At cost
BAT - 01	Work order / Administration fee applied per processing batch	Single charge for each batch of samples processed	\$35.00
STR- 01	Monthly archive of samples	Long term storage of samples > 30 days	\$0.35/ sample



Forms and detailed instructions can be downloaded directly from our website

www.portaspecs.com/downloads/

SAMPLE SUBMISSION 8 Portable Spectral Services

SAMPLE TYPE & PREPARATION

Portable Spectral Services appreciates that clients may not have the opportunity to prepare the optimal sample type for the chosen spectral method. Several sample preparation options are offered to ensure accessible and practical quality data with maximum value.

POWDERS, SOIL & SEDIMENT PREPARATION PACKAGE

Drying temperature is kept low to avoid loss of mercury, iodine etc.

CODE	DESCRIPTION	APPLICATION	PRICE PER SAMPLE
PREP - 01	Dry at <60°C/140°F, sieve sample to -180 micron (80 mesh). Retain both fractions	Powders, pulps, soil or sediment samples	\$3.85 +\$4.55 /kg
CUPT - 01	Temporary transfer of sample to pXRF cup for optimum pXRF results	All loose powders, pulps, soil or sediment samples	\$2.00
CUPP - 01	Permanently transfer sample to pXRF cup for optimal results and can be used for multiple pXRF analysis	All loose powders, pulps, soil or sediment samples	\$4.25

MICRO-XRF SAMPLE PREPARATION PACKAGE

CODE DESCRIPTION APPLICATION PRICE PER HOUR CUT- 01 As required for rough and uneven Cut sample to create a flat surface for µXRF analysis \$60.00 rocks & drill core POL - 01 Polish sample surface to create an optimal surface As required for rough and uneven \$75.00 rocks & drill core for µXRF analysis GRD - 01 As required for rough and uneven Grind sample to create an optimal surface for µXRF \$60,00 rocks & drill core analysis EPX - 01 Set friable rocks and drill chips in epoxy resin, cut, As required for friable rocks & drill \$125,00 grind and polish chips MOU - 01 Set mineral grains in epoxy resin, cure, grind and As required for mineral grains \$125.00 polish

These procedures are recommended to obtain optimal results from the micro-XRF

MISCELLANEOUS PROCEDURES

These procedures may be used when specialised preparation is required. An hourly labour charge may apply to time-intensive projects.

CODE	DESCRIPTION	APPLICATION	PRICE PER SAMPLE
TRA - 01	Transfer sample to new kraft sample bag	As required for samples in poor / unsuitable condition	\$1.90
HOM - 01	Homogenise sample pulps and powders	As required	\$8.25
SPL - 01	Split of pulp received for various spectral analysis	Riffle splitting procedure	\$3.00
SCR - 01	Screening of samples to any number of standard size fractions, as specified by the client. Weight of undersize fraction reported for each screen size	Fraction sizing or custom screening as requested e.g2mm+1mm, -1mm+250 μm	\$14.85 / screen size
IMG - DY	Photograph of sample specimen (dry)	Photographic record of sample	\$5.00
IMG - WT	Photograph of sample specimen (wet)	Photographic record of sample	\$5.00

SAMPLE SUBMISSION 9

PORTABLE XRF ANALYSIS

Portable XRF analysis can be used to screen large volumes of soil samples, drill pulps and grade control samples for a wide range of trace and ore grade elements quickly and efficiently, while the standard laboratory test is relatively costly, time consuming and chemical-Intensive.

PORTABLE XRF ANALYSIS

The portable X-ray fluorescence (pXRF) technique generates **indicative assay results** through the use of a generic calibration setup and a thorough QAQC procedure to provide a **comprehensive element and concentration range** that enables them to be used in exploration projects to ore grade control.

Through our extensive **Research and Development program** and a proven track record, **Portable Spectral Services** has partnered with **Bruker** to offer **manufacturer approved** and **client specific calibrations**, which provide superior results to the generic calibration and standardisation approach. This enables **additional elements** to be included and more **precise** and **accurate concentration ranges**.



Portable Spectral Services has also developed a set of manufacturer approved **first principle calibrations** for samples submitted that are not represented in the typical "off the shelf" calibration suite to **optimise value** and **reduce risk** of inaccurate results, including false positives.

POWDERS, PULPS, SOILS AND SEDIMENT

Set UI ennañ			
CODE	DESCRIPTION	APPLICATION	PRICE PER SAMPLE
pSCAN-02	Ag, Al, As, Bi, Ca, Cd, Cr, Cu, Fe, Hg, K, Mg, Mn, Mo, Nb, Ni, P, Pb, Rb, S, Sb, Se, Si, Sn, Sr, Th, Ti, U, V, W, Y, Zn, Zr	Enhanced pXRF scan	\$8.50
pROCK-01*	Whole rock: Na_2O , SiO ₂ , TiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ , MnO, MgO, CaO, K ₂ O, P ₂ O ₅ , Ba, Cr, S, Zr	Lithogeochemistry (rock and alteration identification)	\$9.00
pAU-01	Ag, As, (Au), Bi, Cu, Hg, Mo, Ni, Pb, S, Sb, Se, Te, W, Zn, Cr, Sr, Ti, Zr	Auriferous pathfinder suite	\$6.00
pREE-01	$La_2O_3, CeO_2, Pr_6O_{11,} Nd_2O_3, Sm_2O_3, Eu_2O_3, Gd_2O_3, Y_2O_3$	Rare Earth Elements	Add + \$5.00
pLCT-01	Li**, Cs, Ta, Nb, Ga, Rb, Tl, Sn, W, Ba, Ce, Cr, La, Sr, Ti, Y, Zr	LCT pegmatites	Add + \$5.00
pHLG-01	(F)***, Cl, Br, I	Halogen associated with metal complexing	Add + \$5.00
pELT-01	F (Z9) to U (Z92)	Confirm element presence by analysis & spectral evaluation	\$15.00

To ensure the lowest possible detection limits, PSS has developed a set of enhanced calibrations utilising a helium and/ or vacuum purge.

PSS offers portable XRF analysis on powder, pulps, soil and sediment samples.

CODE	DESCRIPTION	APPLICATION	PRICE PER SAMPLE
pSCAN-01	Ag, Al, As, Bi, Ca, Cd, Cr, Cu, Fe, Hg, K, Mg, Mn, Mo, Nb, Ni, P, Pb, Rb, S, Sb, Se, Si, Sn, Sr, Th, Ti, U, V, W, Y, Zn, Zr	General pXRF scan	\$6.50

* Whole rock analysis undertaken with helium purge.

**Li determined by proxy.

*** PSS has successfully analysed fluorine using a Bruker Tracer with helium purge.

To be successfully detected the fluorine needs to be present in percentage levels.

pXRF & Oils

Fluids such as oils can be readily analysed by pXRF to **detect wear elements**, **additives and meet regulatory requirements**. From January 1 2020 fuel oil used by ships in Australian waters must contain a maximum of 0.5 per cent m/m sulphur. Almost all commercial lubricants contain chemical additives. As part of a preventative maintenance program, analysing oil periodically will reduce the risk of **catastrophic failure**



Portable XRF Fuel oil (including MARPOL)

As of 1st January 2020, fuel oils must contain an maximum of 0.5% m/m sulphur.

CODE	DESCRIPTION	APPLICATION	PRICE PER SAMPLE
pMAR	Sulphur (0.025% to 4.00%)	Fuel oil (MARPOL)	\$5.00
pWAR	Ag, Al, Cu, Cr, Fe, Ni, Pb, Sn, Ti	Wear metal detection	\$6.50
pADD	Ba, Ca, Mg, Mo, S, P, Zn	Oil additives	\$6.50

INDUSTRIAL MINERALS

Industrial minerals have high refractory components requiring aggressive chemical intensive digestions to dissolve all phases. Portable Spectral Services have developed first principle calibrations to provide an affordable alternative to these chemical intensive methods.



POWDERS, PULPS, SOILS AND SEDIMENT

CODE	DESCRIPTION	APPLICATION	PRICE PER SAMPLE
рСМТ	Na ₂ O, SiO ₂ , SO ₃ , TiO ₂ , Al ₂ O ₃ , CaO, Fe ₂ O ₃ , K ₂ O, MgO, MnO, P ₂ O ₅	Cement based materials	\$7.50
pLMT	Na ₂ O, CaO, MgO, Al ₂ O ₃ , Fe ₂ O ₃ , P ₂ O ₅ , SiO ₂	Limestone, dolomite, magnesite, marble	\$7.50

pXRF ELEMENTS AND LIMITS

POWDERS, PULPS, SOILS AND SEDIMENT

ELEMENT	LOWER VALUE (ppm)		UPPER VALUE (percentage)	ELEMENT	LOWER VALUE (ppm)		UPPER VALUE (percentage)	ELEMENT	LOWER VALUE (ppm)	UPPER VALUE (percentage)
Ag	10	-	>1.0	Ga	5	-	>0.5%	S	100 ·	>30%
Al	150	-	>30%	Hf	10	-	>0.5%	Sb	15 -	>30%
As	5	-	>30%	Hg	5	-	>30%	Se	5 -	>0.5%
Au	25	-	>30%	K	50	-	>15%	Si	250 -	>30%
Ba	50	-	>10%	I#	10	-	>1.0%	Sn	15 ·	>30%
Bi	5	-	>30%	La	100	-	>0.5%	Sr	5 -	>1.0%
Br#	10	-	>1.0%	Li*	10	-	>1.0%	Та	10 -	>30%
Са	40	-	>30%	Mg #	150	-	>30%	Те	10 -	>1.0%
Cd	10	-	>1.0%	Mn	10	-	>30%	Th	5 -	>1.0%
Ce	100	-	>1.0%	Мо	5	-	>30%	Ti	50 ·	>30%
Cl	150	-	>5.0%	Na#	400	-	>30%	TI	10 -	>0.5%
Со	100	-	>30%	Nb	5	-	>30%	U	5 -	>1.0%
Cr	10	-	>30%	Ni	5	-	>30%	V	10 -	>30%
Cs	5	-	>25%	Р	50	-	>20%	W	10 -	>30%
Cu	5	-	>30%	Pb	5	-	>30%	Y	5 -	>1.0%
F#	10%	-	>30%	Pd	10	-	>30%	Zn	5 -	>30%
Fe	50	-	>30%	Rb	5	-	>5.0%	Zr	5 -	>30%

NOTES: Induiactive values reported, matrix dependent; *Element derived by proxy #Helium purge required

USEFUL CHEMICAL CONVERSION FACTORS

ELEMENT		FACTOR	COMPOUND	ELEMENT		FACTOR	COMPOUND	ELEMENT		FACTOR	COMPOUND
Al	х	1.889	Al ₂ O ₃	Fe	х	1.43	Fe ₂ O ₃	Pb	Х	1.155	PbS
As	х	1.32	As ₂ O ₃	Fe	х	1.574	FeS	Rb	х	1.094	Rb₂O
В	х	3.22	B ₂ O ₃	К	х	1.205	K₂O	Sb	х	1.197	Sb ₂ O ₃
Ва	х	1.699	BaSO₄	La	х	1.173	La ₂ O ₃	Si	х	2.139	SiO ₂
Ba	х	1.117	BaO	Li	х	2.153	Li ₂ O	Sn	х	1.27	SnO₂
Be	х	2.775	BeO	Mg	х	1.658	MgO	Sr	х	1.183	SrO
Са	х	1.399	CaO	Mg	х	3.648	MgCO ₃	Та	х	1.221	Ta₂O₅
Са	х	2.497	CaCO ₃	Mn	х	1.291	MnO	Th	х	1.138	ThO₂
Ce	х	1.171	Ce ₂ O ₃	Mn	х	1.582	MnO ₂	Ti	х	1.668	TiO₂
Со	х	1.271	CoO	Мо	х	1.5	MoO ₃	U	Х	1.179	U ₃ O ₈
Cr	х	1.462	Cr ₂ O ₃	Мо	х	1.668	MoS ₂	V	Х	1.785	V_2O_5
Cs	х	1.06	Cs ₂ O	Na	х	1.348	Na₂O	W	Х	1.261	WO ₃
Cu	х	1.252	CuO	Nb	х	1.432	Nb ₂ O ₅	Y	х	1.27	Y ₂ O ₃
Cu	х	1.252	Cu ₂ S	Ni	х	1.273	NiO	Zn	Х	1.245	ZnO
F	х	2.055	CaF₂	Р	х	2.291	P ₂ O ₅	Zn	х	1.49	ZnS
Fe	х	1.287	FeO	Pb	х	1.077	PbO	Zr	х	1.351	ZrO ₂

Portable Spectral Services

PORTABLE XRF ANALYSIS 13

SPECTRAL MINERALOGY

INFRARED SPECTROSCOPY

Infrared spectroscopy offers rapid identification and characterisation of minerals.

Common minerals and mineral groups identifiable with infrared spectroscopy include hematite, goethite, kaolin, gibbsite, 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 and characterise mineralogy to **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 an alternative technique on either a continuum or a selected subset of samples.



CODE	DESCRIPTION	APPLICATION	PRICE PER SAMPLE
NIR-TS	Spectral scan using the TerraSpec® 4 HR spectrometer. Crushed reject or RC chips are recommended as the optimal sample type	Optimal for weathered and altered lithologies	\$5.80
NIR-03	Interpretation spreadsheet with mineral assemblages and spectral parameters related to the project geology	Rapid and accurate interpretation of hyperspectral scans using expert software	\$4.95

VERY NEAR INFRARED (VNIR) AND SHORTWAVE INFRARED (SWIR) SPECTROMETRY



FOURIER TRANSFORM INFRARED SPECTROSCOPY (FTIR)

The FTIR instrumentation obtains an **absorption** or emission spectrum in the thermal infrared region for a solid, liquid or gas. Minerals, for example, have unique molecular structures that vibrate upon excitation by an energy source. The resultant spectrum will be characteristic of a mineral based on it's molecular bonding.

Portable Spectral Services has developed a set of FTIR mineral applications using standard analytical pulp to determine the **weight percent** of selected minerals using Attenuated Total Reflection (ATR-FTIR).

As a result of its **rapid analysis time** (<60 seconds), FTIR is **ideal for screening large volumes of sample pulps.** Immobile and larger samples (e.g., chips and core) can also be analysed with ease. Individual mineral phases can be targeted using the onboard video camera to record exact measurement positions.

Through extensive R&D, Portable Spectral Services has investigated numerous mineral systems and developed in-house expertise. Portable Spectral Services offer **customised matrix matched** and **site specific setups** tailored to specific parameters.



FTIR SERVICES

An exciting and emerging technique in the mineral space

CODE	DESCRIPTION	APPLICATION	PRICE PER SAMPLE
FTIR-SCN	Rapid, qualitative scan of sample pulp	A fast method to gain qualitative mineralogy on a prospect or deposit	\$6.95
FTIR-INT	Interpretation spreadsheet with mineral assemblages and spectral parameters related to the project geology	Rapid and accurate interpretation of FTIR scans using expert software	\$4.95
FTIR-SPD	Mineralogy: e.g. Spodumene, Li ₂ O, quartz, K-feldspar, plagioclase and silica: 0.2-100%, 2 gram sample concentrations required	Quantitative mineralogy and Li ₂ O grade	\$6.95
FTIR-AU	Mineralogy: e.g. kaolinite, dickite, pyrophylite, andalucite, muscovite, biotite	Quantitative mineralogy	\$6.95
FTR-REG	E.g. silica, kaolin/gibbsite, smectites, iron-oxides. #	Quantitative oxide mineralogy on a prospect or deposit	\$10.00

#SPD-FTIR requires calibration to be set up with multiple samples from the same deposit that have been analysed by an alternative technique for spodumene, quartz. alkali feldspar, plagiocase & Li₂O to set up a chemometric algorithm.

FOURIER TRANSFORM INFRARED SPECTROSCOPY (FTIR)



ATR-FTIR: EXAMPLE OF MINERALS AND LIMITS

Not an exl	haustive l	ist									
MINERAL PHASE	LOWER VALUE		UPPER VALUE (percentage)	MINERAL PHASE	LOWER VALUE		UPPER VALUE (percentage)	MINERAL PHASE	LOWER VALUE		UPPER VALUE (percentage)
Apatite	1	-	>50%	Kaolinite	1 -	-	>50%	Smectite	1 -	-	>50%
Biotite	1	-	>50%	Mg-Silicates	1 -	-	>50%	Spodumene	1 -	-	>50%
Calcite	1	-	>50%	Muscovite	1-	-	>50%	Tantalum*	1 -	-	>50%
Chlorite	1	-	>50%	Palygorskite	1 -	-	>5%	Alumina*	20 -	-	>50%
Dolomite	1	-	>50%	Plagioclase	1 -	-	>50%	FeOxide*	3 -	-	>25%
Goethite	1	-	>50%	Petalite	1 -	-	>50%	Free Silica*	3 -	-	>25%
Hematite	1	-	>25%	Pollucite	1 -	-	>50%	Titanium*	3 -	-	>25%
Illite	1	-	>50%	Quartz	1 -	-	>50%	Lithium*	3 -	-	>50%
K-Feldspar	1	-	>50%	Siderite	1 -	-	>50%				

*Some elements can be predicted based on the FTIR features of minerals bearing these elements.

RAMAN SPECTROSCOPY

Raman spectroscopy is a **laser based vibrational technique** that generates a unique spectrum that is matched to a known mineral using an extensive mineral library developed in-house. The technique is **non-destructive** and provides a **rapid method to identify minerals** in drill core, rock chips or hand specimens. In addition, mineral assemblages and spectral features related to the project geology can be extracted using spectral software to enhance spectral interpretation.

The application of Raman spectroscopy in the exploration and mining industry is emerging in conjunction with established applications for grade control and ore sorting.

RAMAN SPECTROSCOPY

1

800

Rapid method to identify minerals in drill core, rock chips or hand specimens

700

CODE	DESCRIPTION	APPLICATION	PRICE PER SAMPLE
RAM-SCN	Rapid, qualitative scan of drill core, rock chips or hand specimen samples	A fast method to gain qualitative mineralogy on a prospect or deposit	\$6.95
RAM-LCT	Identification of LCT pegmatite mineral phases using our inhouse RAMAN library	Qualitative mineralogy	\$10.00
RAM-INT	Interpretation spreadsheet with mineral assemblages and spectral parameters related to the project geology	Rapid and accurate interpretation of RAMAN scans using expert software	\$4.95

For the latest information visit www.georaman.com

400

Portable Spectral Services

SPECTRAL MINERALOGY 18

MICRO CHEMISTRY & MINERALOGY

10 mm 🚽

Portable Spectral Services

MICRO-XRF

Micro-XRF is an ideal method for **element mapping** large samples (19 x 16 cm) with little or no sample preparation. The technique is **rapid** and **non-destructive**, and is used to quickly acquire **qualitative** and **quantitative** geochemical data at high spatial resolution (i.e. μ m-scale). Measurements are collected either under normal atmospheric conditions (air) or under vacuum for elements from **sodium** (Na) to uranium (U) with quantification limits ranging from parts per million to percentage.

For the latest information visit www.microXRF.com.au



ELEMENT AND MINERAL MAPPING

Element mapping and identification of mineral phases, in situ, at the micron scale on drill core, drill chips, hand specimens, thin sections etc.

CODE	DESCRIPTION	APPLICATION	PRICE PER SAMPLE**
μXRF-01	Routine scan: scan a standard set area and resolution (1.5 hour scan) and receive a standard report	Elemental mapping drill core, thin sections and rock samples to investigate process and association	\$295.00
μXRF-02	Customised scan for targeted projects goals and objectives, high resolution, large sample size	In depth element mapping investigation to determine process, paragenesis and fluid pathways	\$50.00 - 95.00* per hour
CHEM-M4	Element verification and standard report	Verifying element distribution maps	\$200.00
AMCS-M4	Semi-automated mineralogy, mineral anatomy, distribution and deportment	Identify preliminary geometallurgical and ore quality parameters	\$200.00 per hour (capped at 2 hours)

*price will vary depending on length of scan

** For atypical samples that may require more extenisve chemical or mineral processing beyond the standard parameters. Any additional processing required will only be performed with the clients prior approval.



ADVANCED MINERAL IDENTIFICATION & CHARACTERISATION SYSTEM (AMICS)

Automated mineralogy via AMICS (Advanced Mineral Identification & Characterisation Software) is used to **identify mineral phases**, in situ, at the **micron scale** on drill core, drill chips, hand specimens, thin sections etc. The software identifies the sample mineralogy from geochemical data collected by a micro-XRF instrument.

As well as identifying the minerals present, the mineralogy maps allow visualisation of the textures and spatial arrangements of the minerals. The processed maps can thus be used to determine grain sizes and shapes, as well as provide information on the mineral associations, mineral liberation, elemental deportment and elemental mapping.

AUTOMATED MINERALOGY VIA AMICS

Identify mineral phases, in situ, at the micron scale on drill core, drill chips, hand specimens, thin sections etc.

CODE	DESCRIPTION	APPLICATION	PRICE PER SAMPLE**
AMCS-M4	Semi-automated mineralogy, mineral anatomy, distribution and deportment	Identify preliminary geometallurgical and ore quality parameters	\$200.00 per hour (capped at 2 hours)

** For atypical samples that may require more extenisve mineral processing beyond the standard parameters. Any additional processing required will only be performed with the clients prior approval.



Specific Exploration, Ores & Commodities Packages



Procedures for the evaluation of exploration targets, ores and high-grade materials are optimised for accuracy, precision and recovery of the target elements and/or mineral phases.

No single spectral technique is suitable for all applications. That is why **Portable Spectral Services** provides you with a wide variety of procedures and spectral approaches, so your specific needs can be met.

GOLD

Fluorine,* chlorine, bromine and iodine ligands transport metals, including gold through the crust and regolith as halogen complexes. The identification of these elements present significant applications to mineral exploration and ore characterisation. Conventional analyses are expensive and rely heavily on the use of chemicals, however, PSS offers cost effective, non-destructive analyses for halogen (pHLG-01) targets.



EXPLORATION, DELINEATION, DEFINITION

Procedures for evaluating, vectoring and delineating auriferous systems

CODE	DESCRIPTION		PRICE PER SAMPLE
pAU-01	Ag, As, (Au), Bi, Cu, Hg, Mo, Ni, Pb, S, Sb, Se, Te, W, Zn, Cr, Sr, Ti, Zr	Auriferous pathfinder suite	\$6.00
pSCAN-01	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.	General pXRF scan	\$6.50
pHLG-01	(F)***, Cl, Br, I	Halogen associated with metal complexing	Add + \$5.00
pROCK-01*	Whole rock: Na_2O , SiO_2 , TiO_2 , Al_2O_3 , Fe_2O_3 , MnO, MgO, CaO, K_2O, P_2O_5, Ba, Cr, S, Zr	Lithogeochemistry (rock and alteration identification)	\$9.00
FTIR-AU	Mineralogy: e.g. kaolinite, dickite, pyrophylite, andalucite, muscovite, biotite	Quantitative mineralogy	\$6.95
NIR-01	Spectral scan using the Spectral Evolution SR-6500 ultra-HR spectrometer. Crushed reject or RC chips are recommended as the optimal sample type	To distinguish between minerals with very similar spectra or to discern and identify minerals in trace amounts	\$6.95
NIR-02	Spectral scan using the TerraSpec® 4 HR spectrometer. Crushed reject or RC chips are recommended as the optimal sample type	Optimal for weathered and altered lithologies	\$5.80
NIR-INT	Interpretation spreadsheet with mineral assemblages and spectral parameters related to the project geology	Rapid and accurate interpretation of hyperspectral scans using expert software.	\$4.95
RSCN-M4	μXRF element maps of core and/or chips, down to	Determine element distribution	\$200.00
	25 μ m, this includes all elements from Na to U	and textures	
AMCS-M4	Semi-automated mineralogy, mineral anatomy, distribution and deportment	Identify preliminary geometallurgical and ore quality parameters	\$250.00
PROB-01	μXRF probe mineral grains at 25 μm spot size	Element variation in mineral species (e.g., chromites)	\$250.00 per mount

* Whole rock analysis undertaken with helium purge.

***PSS has successfully analysed fluorine using a Bruker Tracer with helium purge.

To be successfully detected the fluorine needs to be present in percentage levels.

LITHIUM & LCT PEGMATITES

The increasing demand for green technology and battery metals includes Li hosted in LCT pegmatites, representing the most highly differentiated and last to crystallise components of certain granitic melts. PSS has extensive experience with pegmatites and alkaline rocks and the spectral packages below are offered to provide the optimum value for exploration to exploitation.

EXPLORATION, DELINEATION, DEFINITION

Procedures for evaluating and delineating lithium project and deposits

CODE	DESCRIPTION	APPLICATION	PRICE PER SAMPLE
pLCT-01	Li**, Cs, Ta, Nb, Ga, Rb, Tl, Sn, W, Ba, Ce, Cr, La, Sr, Ti, Y, Zr	LCT pegmatites	Add + \$5.00
pROCK-01*	Whole rock: Na_2O , SiO ₂ , TiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ , MnO, MgO, CaO, K ₂ O, P ₂ O ₅ , Ba, Cr, S, Zr	Lithogeochemistry (rock and alteration identification)	\$9.00
FTIR-SPD	Mineralogy: e.g. Spodumene, Li ₂ O, quartz, K-feldspar, plagioclase and silica: 0.2-100%, 2 gram sample concentrations required	Quantitative mineralogy and Li_2O grade	\$6.95
RAM-LCT	Identification of LCT pegmatite mineral phases using our inhouse RAMAN library	Qualitative mineralogy	\$10.00
NIR-01	Spectral scan using the Spectral Evolution SR-6500 ultra-HR spectrometer. Crushed reject or RC chips are recommended as the optimal sample type	To distinguish between minerals with very similar spectra or to discern and identify minerals in trace amounts	\$6.95
NIR-03	Interpretation spreadsheet with mineral assemblages and spectral parameters related to the project geology	Rapid and accurate interpretation of hyperspectral scans using expert software	\$4.95
RSCN-M4	μ XRF element maps of core and/or chips, down to	Determine element distribution and textures	\$200.00
	$25 \mu\text{m}$, this includes all elements from Na to U		
AMCS-M4	Semi-automated mineralogy, mineral anatomy, distribution and deportment	Identify preliminary geometallurgical and ore quality parameters	\$250.00

* Whole rock analysis undertaken with helium purge.

** Li analysis determined by proxy.

The oxidised nature of regolith hosted depositse.g. Ni, Al, Fe, Mn, Cu, Au etc) with low sulphur contents and exotic mineralogy makes these samples ideal for a variety of spectral methods to identify key ore, deleterious/reactive elements and their hosts.

EXPLORATION, DELINEATION, DEFINITION

Including Nickel laterites, bauxite, kaolinite, phosphates

CODE	DESCRIPTION	APPLICATION	PRICE PER SAMPLE
pSCAN-01	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	General pXRF scan	\$6.50
pROCK-01*	Whole rock: Na_2O , SiO_2 , TiO_2 , Al_2O_3 , Fe_2O_3 , MnO, MgO, CaO, K_2O , P_2O_5 , Ba, Cr, S, Zr	Lithogeochemistry (rock and alteration identification)	\$9.00
FTIR-REG	E.g., silica, kaolin/gibbsite, smectite, iron-oxides	Quantitative mineralogy	\$6.95
NIR-01	Spectral scan using the Spectral Evolution SR-6500 ultra-HR spectrometer. Crushed reject or RC chips are recommended as the optimal sample type	To distinguish between minerals with very similar spectra or to discern and identify minerals in trace amounts	\$6.95
NIR-02	Spectral scan using the TerraSpec® 4 HR spectrometer. Crushed reject or RC chips are recommended as the optimal sample type	Optimal for weathered and altered lithologies	\$5.80
NIR-03	Interpretation spreadsheet with mineral assemblages and spectral parameters related to the project geology	Rapid and accurate interpretation of hyperspectral scans using expert software	\$4.95
RSCN-M4	μXRF element maps of core and/or chips, down to	Determine element distribution	\$200.00
	25 $\mu\text{m},$ this includes all elements from Na to U	and textures	
AMCS-M4	Semi-automated mineralogy, mineral anatomy, distribution and deportment	Identify preliminary geometallurgical and ore quality parameters	\$250.00

* Whole rock analysis undertaken with helium purge.



NICKEL SULPHIDES

The composition, mineralogy and paragenesis of disseminated and massive Ni sulphide mineralisation hosted in mafic-ultramafic lithologies can be ascertained through a variety of spectral techniques and optimised to the deposit style. The micro-XRF coupled (RSCN-M4) with AMICS (AMCS-M4) can provide critical information on grain size, deportment and tenor.

EXPLORATION, DELINEATION DEFINITION

Procedures for evaluating and delineating nickel sulphide projects and deposits

CODE	DESCRIPTION	APPLICATION	PRICE PER SAMPLE
pSCAN-01	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	General pXRF scan	\$6.50
pROCK-01*	Whole rock: Na_2O , SiO ₂ , TiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ , MnO, MgO, CaO, K ₂ O, P ₂ O ₅ , Ba, Cr, S, Zr	Lithogeochemistry (rock and alteration identification)	\$9.00
RSCN-M4	μXRF element map of core and/or chips, down to 25 μm , this includes all elements from Na to U	Determine element distribution and textures	\$200.00
AMCS-M4	Semi-automated mineralogy, mineral anatomy, distribution and deportment	Identify preliminary geometallurgical and ore quality parameters	\$250.00
PROB-01	μXRF probe mineral grains at 25 μm spot size	Element variation in mineral species (e.g., tellurides)	\$250.00

* Whole rock analysis undertaken with helium purge.



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Our suite of spectral field-based testing technologies are robust, portable and can be used in the field to generate reliable data in less than 48 hours to meet the ever-evolving need for rapid analytical data for **real-time decision making**.

The spectral field-based testing technologies generate both chemical and mineralogical data and include:

- Portable XRF analysis systems (pXRF)
- Near and Shortwave infrared analysis systems (NIR-SWIR)
- Fourier transform infrared analysis systems (FTIR)
- Raman analysis systems (pRAM)

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Along with your new instrument we will work with you to enhance your user experience by providing a local Level 1 Service Facility where we have an in-house Bruker applications scientist which allows for immediate access to support and expertise. This includes ongoing support in training, licencing, trouble shooting, custom calibrations, project structuring and more.

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	Mb1	1.269	1.325	1.383	1.448	1.503	1.573	1.630	1.700	1.770	1.838	1.906	1.978	2.052	2.127	2.203	2.281	2.363	2.444	2.526	2.614	2.699	2.784	2.868	2.949	3.051	3.149	3.240	3.336	3,435	3.534	3.646
	Ma1	1.240	1.293	1.348	1.404	1.462	1.526	1.580	1.646	1.712	1.775	1.843	1.907	1.980	2.050	2.123	2.195	2.271	2.342	2.423	2.499	2.577	2.654	2.732	2.806	2.900	2.996	3.082	3.171	3.250	3.339	3.438
	Lb1	6.975	50.385	50.385	50.385	50.385	8,402	50.385	50.385	50.385	50.385	50.385	50.385	50.385	11.071	11.443	9.989	10.269	10.551	10.839	11.131	11.427	11.727	12.031	12.339	12.652	12.968	13.291	13.614	13.946	14.282	14.620
	1	273	0.385	0.385	0.385	0.385	416	0.385	0.385	0.385	0.385	0.385	0.385	0.385	442	713	0.255	2.573	4.939	7.349	9,803	2.304	4.886	7,474	0.130	02.846	5,605	18,427	1.303	4.234	7.228	20.284
	1 1	385 6	385 5	385 5	385 5	385 5	382 7.	385 5	385 5	385 5	385 5	385 5	385 5	385 5	750 9.	982 9	818 8	872 8	970 8	107 8	291 8	516 9.	785 9	106 9	478 10	884 10	351 10	868 10	440 11	.059 11	3.734 11	3.472 12
	K b	82 50	99 50	47 50	28 50	42 50	88 59	70 50	90 50	35 50	18 50	1 50	00 50	96 50	31 75	06 77.	18 70	72 72	70 74.	77 77.	91 79,	l6 81.	85 83	96 86	78 88	84 90	51 93	68 95	40 98	101	734 10:	472 10
	Ka1	44,4	45.9	47.5	49.12	50.7	52.3	54.0	55.7	57.53	59.3	61.14	63.0	64.8	66.8	68.8	70.8	72.8	74.9	77.10	79.2	81.51	83.7	86,10	88.4	90.8	93.3	ר 95.8	98.4	101.0	103.7	106.4
	ELEMENT	Terbium	Dysprosium	Holmium	Erbium	Thulium	Ytterbium	Lutetium	Hafnium	Tantalum	Tungsten	Rhenium	Osmium	Iridium	Platinum	Gold	Mercury	Thallium	Lead	Bismuth	Polonium	Astatine	Radon	Francium	Radium	Actinium	Thorium	Protactinium	Uranium	Neptunium	Plutonium	Americium
		Tb	Dy	Ч	Ъ	Ę	٩۲	Γn	Hf	Та	≥	Re	Os	r	Pt	Αu	Нg	F	Ъb	Bi	Ро	At	Rn	Ъ	Ra	Ac	Th	Ра	D	dN	Pu	Am
	Я	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
	Lb1	1.419	1.526	1.636	1.751	1.871	1.998	2.126	2.260	2.394	2.535	2.683	2.834	2.990	3.150	3.315	3.487	3.663	3.842	4.029	4.221	4,418	4.619	4.828	5.038	5.262	5.492	5.719	5.961	6.201	6.458	6.708
	La1	1.379	1.481	1.585	1.692	1.806	1.924	2.044	2.169	2.292	2.423	2.558	2.697	2.838	2.983	3.133	3.286	3.444	3.604	3.768	3.938	4.110	4.285	4.466	4.647	4.839	5.035	5.228	5.432	5.633	5.849	6.053
	Kb1	12,497	13.292	14.112	14.961	15.835	16.739	17.668	18.625	19,606	20.626	21.656	22.724	23,818	24,941	26.093	27.275	28,485	29.725	30,993	32.294	33.620	34,982	36.378	37.797	39.256	40.749	42.272	43.827	45,414	47.038	48,695
	Ka1	11.224	11.924	12.648	13.396	14.165	14.958	15.775	16.615	17.480	18.367	19.279	20.216	21.177	22.163	23.173	24.210	25.271	26.359	27.473	28.612	29.775	30.973	32.194	33,442	34.720	36.027	37.361	38.725	40.118	41.542	42.996
	ELEMENT	Selenium	Bromine	Krypton	Rubidium	Strontium	Yttrium	Zirconium	Niobium	Molybdenum	Technetium	Ruthenium	Rhodium	Palladium	Silver	Cadmium	Indium	Tin	Antimony	Tellurium	lodine	Xenon	Cesium	Barium	Lanthanum	Cerium	Praseodymium	Neodymium	Promethium	Samarium	Europium	Gadolinium
		Se	Br	Ϋ́	Rb	Sr	≻	Zr	ЧN	Мо	ч	Вu	Rh	РЧ	Ag	Cd	<u>_</u>	Sn	Sb	Te	_	Xe	Cs	Ba	La	Се	Pr	ΡN	Pm	Sm	Eu	Gd
	Z	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
	Lb1																		0.35	0.400	0.46	0.52	0.58	0.65	0.72	0.790	0.87	0.95	1.04	1.13	1.22	1.32
	La1																		0.34	0.4	0.45	0.510	0.57	0.64	0.71	0.78	0.85	0.93	1.01	1:1	1.19	1.28
	Kb1										1.302	1.557	1.837	2.139	2.465	2.812	3.190	3.590	4.013	4.464	4.933	5.428	5,947	6,492	7.059	7.649	8.267	8.904	9.570	10.27	10.98	11.73
ies	Ka1		0.108	0.183	0.277	0.392	0.525	0.677	0.849	1.040	1.254	1.486	1.740	2.010	2,309	2.622	2.958	3.314	3.692	4.093	4.512	4.953	5.415	5,900	6.405	6.931	7,480	8.046	8.637	9.251	9.886	10.54
ly Energ	ELEMENT	Lithium	Beryllium	Boron	Carbon	Nitrogen	Oxygen	Fluorine	Neon	Sodium	Magnesium	Aluminum	Silicon	Phosphorus	Sulfur	Chlorine	Argon	Potassium	Calcium	Scandium	Titanium	Vanadium	Chromium	Manganese	Iron	Cobalt	Nickel	Copper	Zinc	Gallium	Germanium	Arsenic
-Ra		:-	Be	ш	ပ	z	0	ш	Ne	Na	Mg	A	Si	٩	S	Ū	Ar	×	Са	Sc	Έ	>	c	Mn	Fe	Со	ïZ	Си	Zn	Ga	Ge	As
×	И	<i>т</i>	4	Ð	9	4	ω	6	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33



SERVICE FEES AND SURCHARGES

- Prices in this schedule are effective from 1st June 2020.
- There is a minimum invoice charge of \$260.00 for routine geochemistry and \$310.00 for all other work.
- All prices in this brochure are calculated on the basis of multiple sample batches; individual sample jobs will be invoiced at 100% surcharge rates and submissions of two samples will carry a 50% surcharge.
- When sample submissions include multiple sample matrices and/or differing analytical requirements, they may be treated as multiple jobs, each attracting minimum job fees or small batch size surcharges.
- All non account work requires payment up front prior to commencement of work.
- Discounts will apply for large batches please contact us to discuss your needs.
- All prices quoted in this schedule are in Australian dollars, and exclude Australian Goods and Services Taxation (GST).

QUALITY ASSURANCE

- 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 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 matrices, in which case additional repeats may be charged for.
- Where the concentration of an element exceeds the capacity of the method selected, re-analysis will be carried out using a more appropriate calibration or technique at the client's expense.

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