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GEOCHEM ANALYSIS

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WELCOME TO SGS

SGS was founded in 1878 and is recognized as the global leader in inspection, testing, verification and monitoring services for international trade in the minerals, agricultural, petroleum and consumer products sectors.

With over 67,000 employees, SGS operates a network of over 1,250 offices and laboratories around the world.

SGS provides support to its clients both as a strategic partner and technical advisor. Through our global network of operations and laboratories, we deliver a broad spectrum of independent quality and quantification services for minerals, geochemical, metallurgical materials as well as coal and coke, bio-fuels, non-ferrous metals, steel and steel-making raw materials, fertilizers, cement and industrial minerals.

The SGS Group has an unique depth and breadth of expertise and experience which is available from our global network.

USING THIS GUIDE

This guide details SGS' core competencies in geochemical analysis and is designed to help you choose the analytical methodology that most appropriately fits your needs. It will direct you to the right methodology for the type of sample, element, and species of that element you need. It also helps you select the smallest number of methods that you need so you can maximize your analytical dollar.

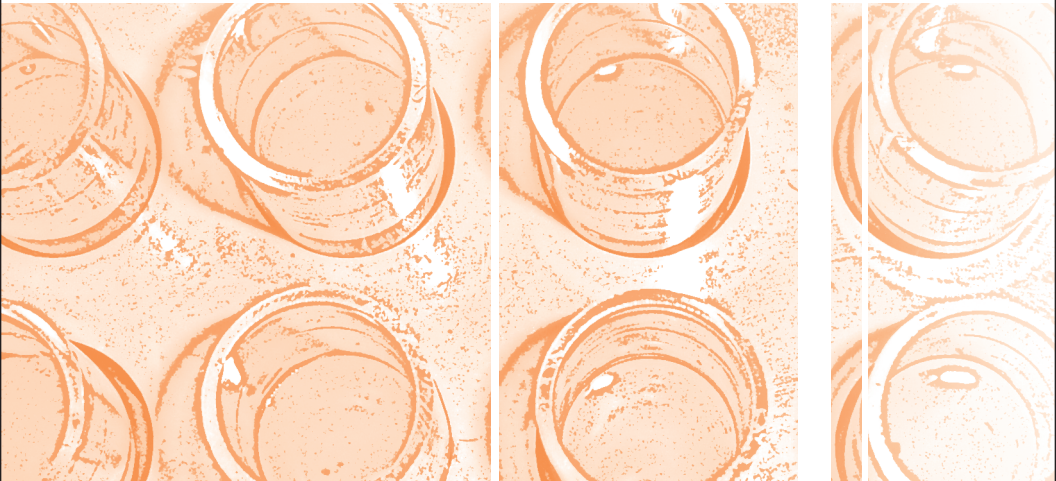
- This guide is divided into a number of sections based on the type of analysis required. Your choice of methods should be driven by the digestion process which supports these measurement techniques. The routine multi-element methods of AAS, ICP-AES and ICP-MS, are included in the 'geochemical analysis' section.
- This guide includes an elements list with determinative procedures highlighted. This Table groups elements into analytical schemes which you can use to pick the best analytical method for your needs.

This guide outlines the most common procedures required by the geological community. These are available through SGS globally. It is accompanied by a fee schedule detailing costs and capabilities in each particular region. While samples may be submitted to any geochem laboratory in the SGS network, certain elements and packages are only available in specific labs. In these cases, clients are notified of any interlab sample transfers by a strict chain-of-custody procedure.

This guide represents only a selection of the methods available at SGS. Please contact SGS to obtain a quote for your particular program. We can help you and supply you with an individual quotation tailored to your needs.

ROCKS TO RESULTS

Rocks to Results, also published by SGS, provides geoscientists with an introduction to geoanalysis. Available at www.sgs.com/geochem, it will provide background to the topics in this service guide.



QUALITY POLICY STATEMENT

SGS is committed to customer satisfaction by providing a consistent level of quality service that sets the industry benchmark. The quality objectives that we measure and assess are:

- The delivery of high quality chemical and mineralogical analysis of rocks, minerals, ores, and other materials in a timely manner.
- The use of methods which are suitably validated, fit-for-purpose and based on internationally recognized methods when possible.
- The use of a Quality Management System that strives to provide customer satisfaction by ensuring, through its documented policies and procedures, that all quality-related activity is clearly demonstrated, assessable and followed.

We will achieve this by:

- Being innovative and providing added-value to your product or service.
- Giving a committed team effort.
- Standardizing of our processes.
- Using a Quality Management System that meets, as a minimum requirement, ISO 9001 and ISO/IEC 17025.
- Employing a detailed quality audit program that ensures corporate and customer feedback.
- Utilizing a continuous improvement system.
- The clever and extensive use of quality control and quality assurance to ensure delivery that exceeds the industry benchmark.
- Providing appropriate staff training.
- Reviewing our Quality System annually.

SGS management and staff are appropriately empowered to ensure these requirements are met. All employees and contractors are familiar with the requirements of the Quality Management System, the above objectives and process outcomes. We welcome feedback on this program.

QUALITY AND RESPONSIVENESS

SGS has an on-going intensive program to monitor quality. Supervised by dedicated quality management personnel, the program is proactive and continuously monitored, enabling us to react promptly to fluctuations in performance.

This proactiveness extends to SGS' market attitude. SGS recognises that not all analytical problems can be solved with routine methodology. A close association with our clients is important, not only to address individual sample batches, but also to address issues that confront the minerals industry as a whole.

The backbone of the “local” service you receive at SGS laboratories is a global quality protocol used by over 100 geochem laboratories. It controls procedures and methodology, data management and reporting, quality control and governing activities, service attitudes and response. Thus you are assured of a uniform, standardized response from any SGS laboratory worldwide. You can trust and rely upon us.

CODE OF ETHICS

Integrity is the core of SGS; it is the common thread through all our activities. Our ethical compliance program is based on our Code of Integrity and Professional Conduct, and ensures that highest standards of integrity are applied to all of our activities worldwide in accordance with international best practice. It has been approved by the SGS Board of Directors and our Operations Council and all SGS employees have been trained in it.

The purpose of this Code is to document rules of behavior and to provide guidance in our day-to-day business. These rules apply to all employees of SGS. Our joint venture partners, agents, intermediaries, consultants and subcontractors are also required to comply with them. It is the responsibility of all of us at SGS, at all levels of our organization, to live by our Code.

Our Code is explained in detail on our website and can be summarized by the following common sense principles:

- Do not do anything which you know or believe to be illegal or unethical.
- Do not use any Company property for your own benefit.
- Do not engage in any transaction which does not have a genuine, legitimate business purpose.
- Ask yourself whether any contemplated transaction or business practice would withstand the scrutiny of the public eye if exposed.
- Do not do anything which could require you to be untruthful.
- Seek advice when in doubt.

YOUR PARTNERSHIP WITH SGS

SGS provides analytical services to all aspects of the minerals industry. SGS' Centres of Excellence are ISO/IEC 17025 accredited and most of our major regional facilities are ISO 9001 certified.

EXPLORATION CLIENTS

Most SGS laboratories provide exploration clients with dedicated sample preparation areas. Centres of Excellence dedicated to geochemical analysis are located strategically around the globe in Belo Horizonte, Johannesburg, Lakefield, Lima, Mwanza, Perth, Toronto, Townsville, Vancouver, Chita, Tianjin and Antofagasta area.

SGS geochemists perform quality, multi-element analyses targeting a wide variety of elements in many types of sample matrices. We have firmly committed to advanced technology such as ICP-AES and ICP-MS instrumentation. This commitment ensures we can deliver on our promise to provide benchmark-setting quality service. Every client's needs are unique; therefore we have both tailored analytical packages and a high-level standardised service offering.

MINING CLIENTS

Mining clients need quality, rapid-turnaround analysis for pit and underground grade control. SGS can also handle mill control analysis. In this case, routine process samples are done with rapid turnaround times (often hours). We offer a wide range of environmental analysis services to help you reduce your operational risks and liabilities. SGS also offers design, construction and management services for on-site laboratories. No matter how remote a project, SGS services can be brought to your site and tailored to your specific needs. We operate close to one hundred labs globally.

SELECTION OF ANALYTICAL METHODS

There are several distinct stages in the evaluation of a project – from a grassroots exploration (early stage) to the final stages of process/grade control at mine development and operation. At each stage, the analytical technique should be carefully considered with respect to the needs of the program. For example, grassroots exploration generally requires geochemical methods based on a partial or weak extraction followed by multi-element analysis. In contrast, analysis for a feasibility stage program generally involve a complete digestion followed by the analysis of a specific elemental suite focused on pay and penalty elements.

In the early stages of exploration, precision, sensitivity and cost are usually key when defining a geochemical anomaly. Accuracy might not be as important as the ability of the method to reproduce and detect subtle anomalies above background or threshold levels. A partial or weak extraction method that is followed by multi-element scans may be acceptable at this stage.

In process or grade control situations, accuracy and precision become critical. A total dissolution of the sample followed by the analysis of specific elements is more appropriate.

There are many different analytical methods available in the industry. More detailed descriptions of the digestion procedures and methods follow in the section entitled Geochemical Analysis to help you with method selection. An SGS Chemist is also always available to assist you with analytical technique selection.

ELECTRONIC DATA AVAILABILITY

Many clients use our web-based data access tool “QLab” (<https://qlab.sgs.com>) for immediate and secure retrieval of their analytical data over the internet. QLab allows you to track the progress of samples and view information such as job status, turn-around-time, scheme/method, client-specific quality control data and the results of your analyses. To maintain the integrity of our sophisticated LIMS (Laboratory Information Management System), QLab does not access the database directly, but instead receives data transmissions on a regular basis.

SAMPLE PREPARATION

Sample preparation is the process by which a sample is readied for analysis. This will almost always involve sub-sampling. The right sampling method will produce a sub-sample that is representative of the total sample. Good sample preparation practice is essential to obtaining meaningful and reliable analytical data. More information is available in Rocks to Results, chapter 4.

SGS is committed to providing preparation procedures that are dedicated to exploration or mining at each of our locations. This involves technologically advanced equipment and, in most cases, physically separated sample processing areas for these very different sample types.

The crushing and pulverizing options available are varied. Your choice can depend on the sample type and the mineral host of the element of interest within the sample matrix. Please consult with our staff for the best possible option for your samples before starting an analytical program.

SGS offers sample preparation services globally and we provide Mobile Sample Prep Units (MSPU) in some of the most remote locations in the world. Our experts can discuss with you the available options and determine which are feasible and meet your requirements in a cost effective manner.

During sample preparation, there are many critical points where sample contamination can occur. One such area arises from the type of equipment used. Unfortunately, during sample preparation, contamination can never be avoided. The levels are dependent on sample hardness, crushing and pulverizing time as well as crushing / grinding media used. Contamination levels can be measured and the table below indicates the type of levels of possible contamination from a variety of grinding media.

BOWL TYPE	SAMPLE CAPACITY	MAIN CONTAMINANT	MINOR CONTAMINANT
Standard Mild Steel Bowl	to 3.5kg	Fe, Cr	Mo
Cr-free Steel	500g to 1.5kg	Fe	Mn
Zirconia	100g	Zr, Hf	Al
Tungsten Carbide	150g	W, Co	Ta
Agate	100g	Si	

SAMPLE PREPARATION

SAMPLE PICK UP AND HANDLING

PKP01	Sample collection / pick up
LOG02	Pre-preparation processing, sorting, logging, boxing etc.
WGH79	Weighing of samples and reporting of weights

SAMPLE PREPARATION PACKAGES

PRP85	Dry, fine pulverise to a nominal 75 μ m (<1.2kg) using bowl-and-puck equipment
PRP86	Dry, fine pulverise to a nominal 75 μ m (<3.0kg) using bowl-and-puck equipment
PRP87	Dry, crush, split, pulverise to a nominal 75 μ m (<1.2kg)
PRP88	Dry, jaw crush (-6mm), fine pulverise to a nominal 75 μ m (<3.0kg) using bowl-and-puck equipment
PRP89	Dry<3kg, crush to 75% passing 2mm, split to 250g and pulverise to 85% passing 75 μ m
PRP90	Dry<3kg, crush to 90% passing 2mm, split to 250g and pulverise to 85% passing 75 μ m

DRYING

DRY10	Dry samples <3.0kg, 105°C
DRY11	Dry samples >3.0kg, 105°C, per kg rate
DRY12	Dry samples <3.0kg, 60°C
DRY13	Dry samples >3.0kg, 60°C, per kg rate
DRY15	Dry excessively wet samples
DRY16	Dry and macerate vegetation

SPLITTING

SPL25	Sample volume reduction - cone and quarter
SPL26	Sample volume reduction - riffle split
SPL27	Sample volume reduction - rotary device

CRUSHING

CRU20	Jaw crush to nominal -6mm
CRU21	Crush <3.0kg to 75% passing 2mm
CRU22	Jaw crush to nominal -2mm using Boyd, Rhino, Nugget or Terminator Crusher
CRU23	Jaw crush <3.0kg, variable mesh size
CRU24	Jaw crush >3.0kg, variable mesh size
CRU25	Crush <3.0kg to 90% passing 2mm

SCREENING

SCR30	Dry screening to -80 mesh, <2kg
SCR32	Dry screening various mesh sizes, <2kg

PULVERIZING

PUL45	Pulverise 250g in Cr steel to 85% passing 75µm
PUL46	Pulverise 500g in Cr steel to 85% passing 75µm
PUL47	Pulverise 1.2kg in Cr steel to 85% passing 75µm
PUL48	Pulverise 3.0kg in Cr steel to 85% passing 75µm
PUL51	Pulverise 500g to 1.2kg, mild steel to 85% passing 75µm
PUL57	Pulverise 100g in agate to 85% passing 75µm

SAMPLE RETURN AND RETENTION

RTN95	Return of residue samples, per/kg
RTN96	Return of pulp sample to client
STO97	Handling / retrieval per hour rate
STO98	Storage pulps
STO99	Storage of rejects for 30 days

MISCELLANEOUS PROCEDURES

COM77	Composite samples
WSH78	Barren flush or wash (used to clean pulverisers)

PRECIOUS METALS ANALYSIS

SPECIAL NOTE: Detection and upper limit can vary slightly among SGS laboratories because some laboratories may not have access to high purity reagents and consumables and/or they may have slight differences in instrumentation. Please talk with your local lab manager to make sure you get the reporting limits you need.

Precious metals (gold, silver and the platinum group elements), can be analyzed by many techniques.

Procedures for gold determinations must account for the type of sample submitted, the purpose of the analysis, sample mineralogy and form of the gold (if known). Lead collection fire assay is considered the most definitive technique while acid digest, accelerated cyanide leaches, BLEG or NAA can be effective for specific purposes.

Similarly, silver can be determined by acid digest or fire assay techniques. Please discuss your particular circumstance with an SGS chemist so you can choose the most appropriate method.

Some platinum group elements can also be determined by lead collection fire assay but this six element suite is best determined by nickel sulfide collection fire assay.

Sulphide-rich samples may require a reduction in sample weight to fuse properly.

PRECIOUS METALS ANALYSIS

CODE	ANALYTE	LIMITS	DESCRIPTION
TRACE LEVELS			
FAA313	Au	5 ppb - 10,000 ppb	30g, Fire Assay, AAS Finish
FAA515	Au	5 ppb - 10,000 ppb	50g, Fire Assay, AAS Finish
FAI313	Au	1 ppb - 10,000 ppb	30g, Fire Assay, ICP Finish
	Pt	10 ppb - 10,000 ppb	Add on Platinum
	Pd	1 ppb - 10,000 ppb	Add on Palladium
FAI515	Au	1 ppb - 10,000 ppb	50g, Fire Assay, ICP Finish
	Pt	10 ppb - 10,000 ppb	Add on Platinum
	Pd	1 ppb - 10,000 ppb	Add on Palladium
FAM303	Au	1 ppb - 2,000 ppb	30g, Fire Assay, ICP-MS Finish
	Pt	0.5 ppb - 2,000 ppb	Add on Platinum
	Pd	0.5 ppb - 2,000 ppb	Add on Palladium

FAM505	Au	1 ppb - 2,000 ppb	50g, Fire Assay, ICP-MS Finish
	Pt	0.5 ppb - 2,000 ppb	Add on Platinum
	Pd	0.5 ppb - 2,000 ppb	Add on Palladium
AAS21E	Ag	0.3 g/t - 300 g/t	2g, 3-acid Digest, AAS Finish
AAS12E	Ag	0.3 g/t - 300 g/t	2g, Aqua Regia Digest, AAS Finish
AAS42E	Ag	0.3 g/t - 300 g/t	2g, 4-acid Digest, AAS Finish

ORE GRADE LEVELS

FAA303	Au	0.01 ppm - 100 ppm	30g, Fire Assay, AAS Finish
FAA505	Au	0.01 ppm - 100 ppm	50g, Fire Assay, AAS Finish
FAG303	Au	3 g/t	30g, Fire Assay, Gravimetric Finish
FAG505	Au	3 g/t	50g, Fire Assay, Gravimetric Finish
FAG313	Ag	5 g/t	30g, Fire Assay, Gravimetric Finish
FAG323	Au, Ag	3 g/t, 5 g/t	30g, Fire Assay, AAS Finish Au, Gravimetric Finish Ag

SCREENED METALLICS

FAS30K	Au	3 g/t	Screen fire assay at 75µm
FAS31K	Au	3 g/t	Screen fire assay at 106µm

Gold by screened metallics fire assay consists of:

- 500g screened at 106 µm (or otherwise specified)
- assay of entire plus fraction
- duplicate assay of minus fraction
- calculation and reporting of size fraction weights, coarse and fine fraction gold content and total gold content

PLATINUM GROUP ELEMENTS

FAI353	Rh	10 ppb - 500 ppb	30g, Rhodium by Fire Assay Palladium In-quart, ICP Finish
FAM363	Pt	1 ppb - 1,000 ppb	30g, Fire Assay Nickel Sulphide Collection, ICP-MS Finish
	Pd	1 ppb - 1,000 ppb	
	Rh	1 ppb - 1,000 ppb	
	Ru	1 ppb - 1,000 ppb	
	Ir	1 ppb - 1,000 ppb	
	Os	3 ppb - 1,000 ppb	Osmium is an add on by Neutron Activation at an Extra Cost

GOLD BY ACID DIGESTION (AQUA REGIA) - TRACE LEVEL

ARE145	Au	1 ppb - 100 ppb	50g, Aqua Regia Digestion, DIBK Extraction, AAS Finish
ARE133	Au	0.01 ppm - 100 ppm	25g, Aqua Regia Digestion, AAS Finish
ARE155	Au	0.01 ppm - 100 ppm	50g, Aqua Regia Digestion, AAS Finish
ARM133	Au	1 ppb - 500 ppb	25g, Aqua Regia Digestion, ICP-MS Finish
ARM155	Au	1 ppb - 500 ppb	50g, Aqua Regia Digestion, ICP-MS Finish

NOTE: ARM133 and ARM155 are not available at all locations.

CYANIDE EXTRACTABLE GOLD

BLE643	Au		Hot, 30g, Mini Cyanide Leach, AAS Finish
BLE61K	Au		500g, Active Cyanide Leach, 24 hr. Solvent Extraction, AAS Finish
BLE61N	Au		2000g, Active Cyanide Leach, 24 hr. Solvent Extraction, AAS Finish
BLL61K	Au		500g, Active Cyanide Leach, 24 hr. ICP-MS Finish
BLL61N	Au		2000g, Active Cyanide Leach, 24 hr. ICP-MS Finish
BLL62N	Au		2000g, Static Cyanide Leach, 24 hr. ICP-MS Finish

ACCELERATED CYANIDE LEACH

LWL69K	Au	0.01 ppm - 1,000 ppm	500g, Accelerated Cyanide Leach
LWL69L	Au	0.01 ppm - 1,000 ppm	800g, Accelerated Cyanide Leach
LWL69M	Au	0.01 ppm - 1,000 ppm	1000g, Accelerated Cyanide Leach

GOLD CYANIDE LIQUOR ANALYSIS

SOL81T	Au	0.001 mg/L - 1,000 mg/L	Au in Liquor, AAS Finish
SOL86V	Au	0.02 mg/L - 10,000 mg/L	Fire Assay, Denver Precipitation
SOL85V	Au	5 mg/L - 10,000 mg/L	Free Cyanide by Titration
SOL81X	Au	0.01 mg/L - 50 mg/L	Solvent Extraction, AAS Finish

GOLD CARBON ANALYSIS

FAA01V	Au	5 ppm - 50,000 ppm	1g, Fire Assay, AAS Finish
ARS12D	Au	2 ppm - 50,000 ppm	Ash, Acid Digestion, 1g Extraction, AAS Finish
FAG01V	Au	5 ppm - 100,000 ppm	Fire Assay, Gravimetric Finish

GOLD BULLION ANALYSIS

BUL16A	Base Metals	0.1% - 5%	Aqua Regia Digestion, Base Metals in Bullion
BUL36V	Au	30% - 99.5%	100mg, Gold in Bullion Fire Assay, Gravimetric Finish
BUL37V	Ag	0.1% - 30%	100mg, Silver in Bullion Fire Assay, Gravimetric Finish

GEOCHEMICAL ANALYSIS

MULTI-ELEMENT TRACE, TRACE ICP-AES AND ICP-MS PACKAGES

A variety of approaches can be used for geochemical analysis depending on your needs. Each approach consists of a digestion technique and a instrumentation technique or "finish". Each combination provides a unique suite of elements and specific upper and lower reporting limits.

SAMPLE DECOMPOSITION / DIGESTION

This is the most important criteria to consider when deciding on a package. Therefore this section of the analysis guide is structured by type of digestion. There are several types of digestion available. Please refer to the following packages for a description of each.

1. Aqua regia digestion
2. Multi-acid (two, three or four acid) digestion
3. Sodium peroxide fusion
4. Lithium metaborate fusion

Rocks to Results also provides more details in Chapter 4.2.

Typically, reconnaissance samples (or regional soil samples) are analyzed by aqua regia digestion followed by a multi-element ICP-AES or ICP-MS scan for base metals, trace and lithological elements.

Core from follow-up drilling, and rock samples are generally analyzed by a multi-acid or fusion digestion followed by a multi-element scan to ensure the refractory minerals are digested. Where metal contents are high (or ore grade), samples can require further testing to ensure data is precise and accurate enough for regulatory reporting.

INSTRUMENTATION

ICP-AES and ICP-MS are the most widely used instrumentation techniques because they yield many elements concurrently. These instruments are widely accepted in the mining and mineral exploration industry as rapid and cost-effective means of analysis. Other instruments that can be used are AAS (Atomic Absorption Spectrophotometer) and Hydride AAS.

TWO-ACID DIGEST/ AQUA REGIA DIGEST

SPECIAL NOTE: Detection and upper limit can vary slightly among SGS laboratories because some laboratories may not have access to high purity reagents and consumables and/or they may have slight differences in instrumentation. Please talk with your local lab manager to make sure you get the reporting limits you need.

The following packages are based on a two-acid digest (a combination of HNO₃ and HCl). After the digestion, the solution is analyzed by either ICP-AES or ICP-MS or both. We can also analyze these digestions by Hydride AAS to determine the volatile elements (Sb, As, Bi, Se, Te). Two-acid digests are the weakest of the digestions and will not attack silicate minerals. As such, the leach provides partial results for most elements.

The methods listed below with the designation "12" are based on a combination of 2:1 HNO₃ : HCl. This digest is recommended for samples with organic or high sulphide content*.

The methods listed below with the designation "14" are based on a combination of 3:1 HCl : HNO₃. This digest is an aqua regia digest and is recommended for all samples which contain no organic material and are low in sulphide content.

All elements and limits are identical in the "12" and "14" digests.

ICP12B AND ICP14B

34 ELEMENTS BY 2:1 HNO₃ / HCl OR 3:1 HCl / HNO₃ WITH ICP-AES FINISH

LIMITS			LIMITS			LIMITS		
Ag	2ppm	- 10ppm	Hg	1ppm	- 1%	Sb	5ppm	- 1%
Al	0.01%	- 15%	K	0.01%	- 15%	Sc	0.5ppm	- 1%
As	3ppm	- 1%	La	0.5ppm	- 1%	Sn	10ppm	- 1%
Ba	5ppm	- 1%	Li	1ppm	- 1%	Sr	0.5ppm	- 1%
Be	0.5ppm	- 0.25%	Mg	0.01%	- 15%	Ti	0.01%	- 15%
Bi	5ppm	- 1%	Mn	2ppm	- 1%	V	1ppm	- 1%
Ca	0.01%	- 15%	Mo	1ppm	- 1%	W	10ppm	- 1%
Cd	1ppm	- 1%	Na	0.01%	- 15%	Y	0.5ppm	- 1%
Cr	1ppm	- 1%	Ni	1ppm	- 1%	Zn	1ppm	- 1%
Co	1ppm	- 1%	P	0.01%	- 15%	Zr	0.5ppm	- 1%
Cu	0.5ppm	- 1%	Pb	2ppm	- 1%			
Fe	0.01%	- 15%	S	0.01%	- 5%			

IMS12B AND IMS14B

36 ELEMENTS BY 2:1 HNO₃:HCl / ICP-MS FINISH

Ag	0.01ppm - 10ppm	Ga	0.1ppm - 1%	Sb	0.05ppm - 1%
Al	0.01% - 10%	Hg	0.01ppm - 100ppm	Sc	0.1ppm - 1%
As	1ppm - 1%	K	0.01% - 10%	Sn	0.3ppm - 0.1%
Ba	5ppm - 1%	La	0.1ppm - 1%	Sr	0.5ppm - 1%
Bi	0.02ppm - 1%	Mg	0.01% - 15%	Th	0.1ppm - 1%
Ca	0.01% - 15%	Mn	2ppm - 1%	Ti	0.01% - 10%
Cd	0.01ppm - 1%	Mo	0.05ppm - 1%	Tl	0.02ppm - 1%
Ce	0.05ppm - 0.1%	Na	0.01% - 10%	U	0.05ppm - 1%
Co	0.1ppm - 1%	Ni	0.5ppm - 1%	V	1ppm - 1%
Cr	1ppm - 1%	P	50ppm - 1%	W	0.1ppm - 1%
Cu	0.5ppm - 1%	Pb	0.2ppm - 1%	Y	0.05ppm - 1%
Fe	0.01% - 15%	Rb	0.2ppm - 1%	Zn	1ppm - 1%

The following elements can be added to above package:
Dy, Er, Eu, Gd, Nd, Pr, Re, Sm, Yb

*High sulfide content is defined as over 10%.

ICM12B AND ICM14B

52 ELEMENTS BY 2:1 HNO₃:HCl / ICP-AES AND ICP-MS FINISH

LIMITS		LIMITS		LIMITS	
Ag	0.01ppm - 10ppm	Hg	0.01ppm - 1%	Se	1ppm - 0.1%
Al	0.01% - 15%	In	0.02ppm - 0.05%	Sn	0.3ppm - 0.1%
As	1ppm - 1%	K	0.01% - 25%	Sr	0.5ppm - 1%
B	10ppm - 1%	La	0.1ppm - 1%	Ta	0.05ppm - 1%
Ba	5ppm - 1%	Li	1ppm - 5%	Tb	0.02ppm - 1%
Be	0.1ppm - 0.01%	Lu	0.01ppm - 0.1%	Te	0.05ppm - 0.1%
Bi	0.02ppm - 1%	Mg	0.01% - 15%	Th	0.1ppm - 1%
Ca	0.01% - 15%	Mn	2ppm - 1%	Ti	0.01% - 15%
Cd	0.01ppm - 1%	Mo	0.05ppm - 1%	Tl	0.02ppm - 1%
Ce	0.05ppm - 0.1%	Na	0.01% - 15%	U	0.05ppm - 1%
Co	0.1ppm - 1%	Nb	0.05ppm - 0.1%	V	1ppm - 1%
Cr	1ppm - 1%	Ni	0.5ppm - 1%	W	0.1ppm - 1%
Cs	0.05ppm - 0.1%	P	50ppm - 1%	Y	0.05ppm - 1%
Cu	0.5ppm - 1%	Pb	0.2ppm - 1%	Yb	0.1ppm - 0.01%
Fe	0.01% - 15%	Rb	0.2ppm - 1%	Zn	1ppm - 1%

Ga 0.1ppm - 1%	S 0.01% - 5%	Zr 0.5ppm - 1%
Ge 0.1ppm - 1%	Sb 0.05ppm - 1%	
Hf 0.05ppm - 0.05%	Sc 0.1ppm - 1%	

The following elements can be added to above package:
Dy, Er, Eu, Gd, Nd, Pr, Re, Sm

HAS12B AND HAS14B

HYDRIDE ELEMENTS 2:1 HNO₃:HCl / HYDRIDE AAS FINISH

LIMITS		
Antimony	Sb	0.1ppm - 500ppm
Arsenic	As	0.1ppm - 500ppm
Bismuth	Bi	0.1ppm - 500ppm
Selenium	Se	0.1ppm - 500ppm
Tellurium	Te	0.1ppm - 500ppm

ARM133 AND ARM155

30g O 50g HNO₃:HCl / ICP-MS FINISH

LIMITS		LIMITS		LIMITS	
Ag 0.02ppm - 100ppm	Hg 0.02ppm - 1000ppm	Se 0.5ppm - 2500ppm			
As 0.5ppm - 2000ppm	Ho 0.01ppm - 2000ppm	Sm 0.02ppm - 1000ppm			
Au 1ppb - 500ppb	In 0.01ppm - 2000ppm	Sn 0.05ppm - 1000ppm			
Ba 0.5ppm - 5000ppm	La 0.05ppm - 2000ppm	Sr 0.1ppm - 1000ppm			
Be 0.02ppm - 1000ppm	Li 0.01ppm - 2000ppm	Ta 0.01ppm - 1000ppm			
Bi 0.01ppm - 2000ppm	Lu 0.02ppm - 1000ppm	Tb 0.005ppm - 1000ppm			
Cd 0.02ppm - 1000ppm	Mn 0.5ppm - 5000ppm	Te 0.05ppm - 1000ppm			
Ce 0.05ppm - 2000ppm	Mo 0.02ppm - 2000ppm	Th 0.01ppm - 1000ppm			
Co 0.1ppm - 1000ppm	Nb 0.02ppm - 2000ppm	Tl 0.01ppm - 1000ppm			
Cs 0.01ppm - 1000ppm	Nd 0.05ppm - 2000ppm	U 0.01ppm - 1000ppm			
Cu 1ppm - 5000ppm	Ni 0.5ppm - 5000ppm	W 1ppm - 1000ppm			
Dy 0.01ppm - 2000ppm	Pb 0.2ppm - 1000ppm	Y 0.02ppm - 1000ppm			
Er 0.01ppm - 2000ppm	Pr 0.01ppm - 1000ppm	Yb 0.01ppm - 1000ppm			
Eu 0.01ppm - 2000ppm	Rb 0.05ppm - 1000ppm	Zn 1ppm - 5000ppm			
Ga 0.05ppm - 1000ppm	Re 0.01ppm - 100ppm	Zr 0.1ppm - 2000ppm			
Gd 0.01ppm - 2000ppm	Sb 0.02ppm - 1000ppm				
Hf 0.01ppm - 2000ppm	Sc 0.1ppm - 1000ppm				

NOTE: ARM133 and ARM155 are not available at all locations.

MULTI-ACID (4 ACID) DIGESTIONS

SPECIAL NOTE: Detection and upper limit can vary slightly among SGS laboratories because some laboratories may not have access to high purity reagents and consumables and/or they may have slight differences in instrumentation. Please talk with your local lab manager to make sure you get the reporting limits you need.

HYDROFLUORIC, PERCHLORIC, HYDROCHLORIC AND NITRIC ACID DIGEST

Multi-acid digestion uses a combination of HCl (hydrochloric acid), HNO₃ (nitric acid), HF (hydrofluoric acid) and HClO₄ (perchloric acid). Because hydrofluoric acid dissolves silicate minerals, these digestions are often referred to as “near-total digestions”. However, there can be a loss of volatiles (e.g. B, As, Pb, Ge, Sb) during this type of digestion.

Multi-acid (4 acid) digestion is a very effective dissolution procedure for a large number of mineral species and is suitable for a wide range of elements.

For more details, see our publication, Rocks to Results, chapter 4.

ICP40B

32 ELEMENTS BY FOUR-ACID DIGESTION / ICP-AES

LIMITS		LIMITS		LIMITS	
Ag	2ppm - 10ppm	Fe	0.01% - 15%	Sb	5ppm - 1%
Al	0.01% - 15%	K	0.01% - 15%	Sc	0.5ppm - 1%
As	3ppm - 1%	La	0.5ppm - 1%	Sn	10ppm - 1%
Ba	1ppm - 1%	Li	1ppm - 1%	Sr	0.5ppm - 1%
Be	0.5ppm - 0.25%	Mg	0.01% - 15%	Ti	0.01% - 15%
Bi	5ppm - 1%	Mn	2ppm - 1%	V	2ppm - 1%
Ca	0.01% - 15%	Mo	1ppm - 1%	W	10ppm - 1%
Cd	1ppm - 1%	Na	0.01% - 15%	Y	0.5ppm - 1%
Cr	1ppm - 1%	Ni	1ppm - 1%	Zn	1ppm - 1%
Co	1ppm - 1%	P	0.01% - 15%	Zr	0.5ppm - 1%
Cu	0.5ppm - 1%	Pb	2ppm - 1%		

The following elements can be added to above package:
Ce, Hf, Nb, Rb, Se, Te, Th, U

Some elements have limited solubility when they occur in certain minerals and other elements can precipitate from solution. See the following tables for details.

ELEMENTS WHICH CAN VOLATILIZE

As	Si	Se
Sb	Sn	Te

ELEMENTS WHICH CAN PRECIPITATE OR HAVE LIMITED SOLUBILITY

Al	Mn	Ti
Ba	Nb	Ta
Cr	Pb	W
Hf	Sb	Zr
Mo	Sn	

ICM40B

49 ELEMENTS BY FOUR-ACID DIGESTION / ICP-AES AND ICP-MS

	LIMITS		LIMITS		LIMITS
Ag	0.02ppm - 10ppm	K	0.01% - 15%	Sn	0.3ppm - 0.1%
Al	0.01% - 15%	La	0.1ppm - 1%	Sr	0.5ppm - 1%
As	1ppm - 1%	Li	1ppm - 1%	Ta	0.05ppm - 1%
Ba	1ppm - 1%	Lu	0.01ppm - 0.1%	Tb	0.05ppm - 1%
Be	0.1ppm - 0.25%	Mg	0.01% - 15%	Te	0.05ppm - 0.1%
Bi	0.04ppm - 1%	Mn	2ppm - 1%	Th	0.2ppm - 1%
Ca	0.01% - 15%	Mo	0.05ppm - 1%	Ti	0.01% - 15%
Cd	0.02ppm - 1%	Na	0.01% - 15%	Tl	0.02ppm - 1%
Ce	0.05ppm - 0.1%	Nb	0.1ppm - 0.1%	U	0.05ppm - 1%
Cs	5ppm - 0.1%	Ni	0.5ppm - 1%	V	2ppm - 1%
Cr	1ppm - 1%	P	50ppm - 15%	W	0.1ppm - 1%
Co	0.1ppm - 1%	Pb	0.5ppm - 1%	Y	0.1ppm - 1%
Cu	0.5ppm - 1%	Rb	0.2ppm - 1%	Yb	0.1ppm - 0.1%
Fe	0.01% - 15%	S	0.01% - 5%	Zn	1ppm - 1%
Ga	0.1ppm - 0.05%	Sb	0.05ppm - 1%	Zr	0.5ppm - 1%
Hf	0.02ppm - 0.05%	Sc	0.5ppm - 1%		
In	0.02ppm - 0.05%	Se	2ppm - 0.1%		

The following elements can be added to the above package:
Dy, Er, Eu, Gd, Ho, Nd, Pr, Sm

HAS40B

HYDRIDE ELEMENTS BY FOUR-ACID DIGESTION / HYDRIDE AAS

Selenium	Se	0.2ppm - 1000ppm
Tellurium	Te	0.5ppm - 1000ppm

AAS42S

FOUR-ACID, (HYDROFLUORIC, PERCHLORIC, HYDROCHLORIC AND NITRIC ACID) DISSOLUTION TO QUANTIFY MAJOR ELEMENT CONCENTRATIONS. AAS FINISH

Ag	5ppm - 500ppm	Cr	50ppm - 5%	Pb	20ppm - 2.5%
As	0.025% - 5%	Cu	10ppm - 50%	Sb	100ppm - 2%
Bi	50ppm - 5000ppm	Fe	0.01% - 40%	V	50ppm - 5%
Ca	0.01% - 40%	Mn	10ppm - 5%	Zn	10ppm - 5%
Cd	5ppm - 5000ppm	Mo	20ppm - 5%		
Co	20ppm - 2.5%	Ni	10ppm - 5%		

ICP42S

FOUR-ACID, (HYDROFLUORIC, PERCHLORIC, HYDROCHLORIC AND NITRIC ACID) DISSOLUTION TO QUANTIFY MAJOR ELEMENT CONCENTRATIONS. ICP-AES FINISH

LIMITS		LIMITS		LIMITS	
Ag	5ppm - 250ppm	Fe	250ppm - 100%	Pb	25ppm - 2.5%
Al	250ppm - 40%	K	0.1% - 40%	Sb	10ppm - 2%
As	20ppm - 2.5%	Li	5ppm - 2500ppm	Sn	20ppm - 2%
Bi	50ppm - 2.5%	Mg	50ppm - 40%	Ta	50ppm - 2.5%
Ca	0.01% - 40%	Mn	20ppm - 10%	Ti	20ppm - 5%
Cd	5ppm - 2%	Mo	20ppm - 2.5%	V	5ppm - 2.5%
Co	10ppm - 2.5%	Na	100ppm - 40%	Zn	10ppm - 5%
Cr	20ppm - 5%	Ni	20ppm - 2.5%	Zr	10ppm - 5%
Cu	10ppm - 2.5%	P	0.01% - 25%		

AAS43B**FOUR-ACID (HYDROFLUORIC, PERCHLORIC, HYDROCHLORIC AND NITRIC ACID)
WITH HIGHER ELEMENTAL CONCENTRATIONS. AAS FINISH**

Ag	50ppm - 4%	Cr	0.03% - 40%	Mo	0.02% - 40%
Al	0.1% - 100%	Cu	0.01% - 100%	Na	0.01% - 50%
As	0.02% - 40%	Fe	0.02% - 100%	Ni	0.01% - 50%
Bi	0.05% - 4%	K	0.01% - 50%	Pb	0.01% - 40%
Ca	0.01% - 50%	Mg	0.01% - 50%	Sb	0.05% - 10%
Cd	50ppm - 4%	Mn	0.01% - 40%	Zn	0.01% - 100%
Co	0.01% - 2.5%				

FUSION PACKAGES

SPECIAL NOTE: Detection and upper limit can vary slightly among SGS laboratories because some laboratories may not have access to high purity reagents and consumables and/or they may have slight differences in instrumentation. Please talk with your local lab manager to make sure you get the reporting limits you need.

Fusion involves the complete dissolution of the sample in molten flux. Fusions are generally more aggressive than acid dissolution methods and are suitable for many refractory, difficult-to-dissolve minerals (such as chromite, ilmenite, spinel, cassiterite and Ta and W minerals). Fusions are presumed to be “total” by the industry.

For more details, see our publication, Rocks to Results, chapter 4.

SODIUM PEROXIDE FUSION

Sodium peroxide fusion is a lower temperature fusion compared to lithium metaborate fusion. Hydride elements are not volatilized.

ICP90A

SODIUM PEROXIDE FUSION / ICP-AES

LIMITS		LIMITS		LIMITS	
Al	0.01% - 25%	K	0.1% - 25%	Sc	5 ppm - 5%
As	30 ppm - 10%	La	10 ppm - 10%	Sn	50 ppm - 5%
Ba	10 ppm - 10%	Li	10 ppm - 10%	Sr	10 ppm - 1%
Be	5 ppm - 2.5%	Mg	0.01% - 30%	Ti	0.01% - 25%
Ca	0.1% - 35%	Mn	10 ppm - 10%	V	10 ppm - 5%
Cd	10 ppm - 5%	Mo	10 ppm - 10%	W	50 ppm - 5%
Cr	10 ppm - 10%	Ni	10 ppm - 10%	Y	5 ppm - 5%
Co	10 ppm - 10%	P	0.01% - 25%	Zn	10 ppm - 10%
Cu	10 ppm - 10%	Pb	20 ppm - 10%		
Fe	0.01% - 30%	Sb	50 ppm - 10%		

ICP90B**SODIUM PEROXIDE FUSION / ICP-AES - NICKEL LATERITE PACKAGE (INCLUDES DRYING AT 105°C FOR 8 HRS.)**

Al ₂ O ₃	0.01% - 25%	Fe ₂ O ₃	0.01% - 30%	P ₂ O ₅	0.01% - 25%
CaO	0.1% - 35%	K ₂ O	0.1% - 25%	SiO ₂	0.01% - 25%
Cr	0.01% - 10%	MgO	0.01% - 30%	TiO ₂	0.01% - 25%
Co	0.01% - 10%	MnO	0.01% - 10%		
Cu	0.01% - 10%	Ni	0.01% - 10%		

ICM90A**55 ELEMENTS BY SODIUM PEROXIDE FUSION / ICP-AES AND ICP-MS**

	LIMITS		LIMITS		LIMITS
Ag	1ppm - 0.1%	Ge	1ppm - 0.1%	Sb	0.5ppm - 1%
Al	0.01% - 25%	Hf	1ppm - 1%	Sm	0.1ppm - 0.1%
As	5ppm - 10%	Ho	0.05ppm - 0.1%	Sn	1ppm - 1%
Ba	0.5ppm - 1%	In	0.2ppm - 0.1%	Sr	0.1ppm - 1%
Be	5ppm - 0.25%	K	0.1% - 25%	Ta	0.5ppm - 1%
Bi	0.1ppm - 0.1%	La	0.1ppm - 1%	Tb	0.05ppm - 0.1%
Ca	0.1% - 35%	Li	10ppm - 5%	Th	0.1ppm - 0.1%
Cd	0.2ppm - 1%	Lu	0.05ppm - 0.1%	Ti	0.01% - 25%
Ce	0.1ppm - 1%	Mg	0.01% - 30%	Tl	0.5ppm - 0.1%
Co	0.5ppm - 1%	Mn	10ppm - 10%	Tm	0.05ppm - 0.1%
Cr	10ppm - 10%	Mo	2ppm - 1%	U	0.05ppm - 0.1%
Cs	0.1ppm - 1%	Nb	1ppm - 1%	V	5ppm - 1%
Cu	5ppm - 1%	Nd	0.1ppm - 1%	W	1ppm - 1%
Dy	0.05ppm - 0.1%	Ni	5ppm - 1%	Y	0.5ppm - 0.1%
Er	0.05ppm - 0.1%	P	0.01% - 25%	Yb	0.1ppm - 0.1%
Eu	0.05ppm - 0.1%	Pb	5ppm - 1%	Zn	5ppm - 1%
Fe	0.01% - 30%	Pr	0.05ppm - 0.1%	Zr	0.5ppm - 1%
Ga	1ppm - 0.1%	Rb	0.2ppm - 1%		
Gd	0.05ppm - 0.1%	Sc	5ppm - 5%		

HAS90A**HYDRIDE ELEMENTS BY SODIUM PEROXIDE FUSION / HYDRIDE AAS**

As 0.5ppm - 1000ppm Bi 0.5ppm - 1000ppm Sb 0.5ppm - 1000ppm

LITHIUM METABORATE FUSION

Lithium metaborate fusion dissolves the major rock-forming minerals of a sample as well as many trace minerals. ICP95A is a lithologic package which includes major and some trace elements analyzed via ICP-AES. For a further suite of trace elements, the same solution is analyzed via ICP-MS. See below: IMS95A

ICP95A**18 ELEMENTS BY LITHIUM METABORATE FUSION / ICP-AES
(LITHOLOGIC PACKAGE)**

LIMITS		LIMITS		LIMITS	
Al ₂ O ₃	0.01% - 75%	MgO	0.01% - 30%	Sr	10ppm - 10%
Ba	10ppm - 10%	MnO	0.01% - 10%	TiO ₂	0.01% - 25%
CaO	0.01% - 60%	Na ₂ O	0.01% - 30%	Y	10ppm - 10%
Cr ₂ O ₃	0.01% - 10%	Nb	10ppm - 10%	Zn	5ppm - 1%
Fe ₂ O ₃	0.01% - 75%	P ₂ O ₅	0.01% - 25%	Zr	10ppm - 10%
K ₂ O	0.01% - 25%	SiO ₂	0.01% - 90%	LOI	0.01% - 50%

IMS95A**TRACE ELEMENTS BY LITHIUM METABORATE FUSION / ICP-MS**

Ag	1ppm - 0.1%	Ho	0.05ppm - 0.1%	Ta	0.5ppm - 1%
Ce	0.1ppm - 1%	La	0.1ppm - 1%	Tb	0.05ppm - 0.1%
Co	0.5ppm - 1%	Lu	0.05ppm - 0.1%	Th	0.1ppm - 0.1%
Cs	0.1ppm - 1%	Mo	2ppm - 1%	Tl	0.5ppm - 0.1%
Cu	5ppm - 1%	Nb	1ppm - 1%	Tm	0.05ppm - 0.1%
Dy	0.05ppm - 0.1%	Nd	0.1ppm - 1%	U	0.05ppm - 1%
Er	0.05ppm - 0.1%	Ni	5ppm - 1%	V	5ppm - 1%
Eu	0.05ppm - 0.1%	Pr	0.05ppm - 0.1%	W	1ppm - 1%
Ga	1ppm - 0.1%	Rb	0.2ppm - 1%	Yb	0.1ppm - 0.1%
Gd	0.05ppm - 0.1%	Sm	0.1ppm - 0.1%		
Hf	1ppm - 1%	Sn	1ppm - 1%		

ORE-GRADE ANALYSIS

Ore-grade analysis is the high accuracy and precision analysis of mineralized geological samples containing percent levels of elements. If ICP geochemical multi-element analysis is chosen for such samples, the upper detection limits for some elements can be exceeded. In such cases, results are reported as ">". At this point, to achieve suitable precision and accuracy, these elements must be analyzed using a different technique. This ore-grade analysis is typically performed using a sodium peroxide fusion - ICP-AES analyses. Then, the precision is better than 5%.

The techniques used in these methods are quantitative and intended for use in delineation drilling programs. Please consult with us to ensure that the proper method is chosen.

ICP90Q

ELEMENTS		LIMITS
Cobalt	Co	0.01%*
Copper	Cu	0.01%
Lead	Pb	0.01%
Molybdenum	Mo	0.01%
Nickel	Ni	0.01%
Zinc	Zn	0.01%

*100 ppm

Additional elements may be requested.

MOBILE METAL ION GEOCHEMISTRY - MMI®

SGS is the owner and sole provider of MMI® Technology. We have over 15 years of experience with this technology, and we are the market leaders in providing a weak extraction of the mobile form of the ions residing in near surface soils. MMI® is a world-renowned geochemical tool proven to find buried mineral deposits.

MMI® Technology is an innovative analytical process that uses a unique approach to the analysis of metals in soils and weathered materials. Target elements are extracted using weak solutions of organic and inorganic compounds rather than conventional aggressive acid or cyanide-based digests. MMI® solutions contain strong ligands, which detach and hold in solution the metal ions that were loosely bound to soil particles by weak atomic forces. The extraction does not dissolve the bound forms of the metal ions. Thus, the metal ions in the MMI solutions are the chemically active or 'mobile' component of the sample. Because these mobile, loosely bound complexes are in very low concentrations, measurement is by conventional ICP-MS and the latest evolution of this technology, ICP-MS Dynamic Reaction Cell™ (DRC IIT™).

There are many benefits to using MMI® Technology for soil geochemistry:

- Few false anomalies
- Focused anomalies
- Minimal nugget effects

SAMPLE COLLECTION

Sample collection is the most critical part of a soil geochemistry program. The MMI® Technology has specific sampling protocols based on years of experience and research. In the absence of an orientation survey, samples must be taken at a constant depth (10-25cm) below the organic-inorganic soil interface. There is no sample preparation or drying. The analysis is done on a 50 gram sample and the extracted solution is analyzed via ICP-MS or ICP-MS DRCIIT™ instruments, that can provide determinations in the part per billion range. For detailed instructions for the MMI® sampling protocols and orientation surveys, please visit www.sgs.com/mining/mmi or contact Pierrette Prince at pierrette.prince@sgs.com.

NEW ANALYTICAL DEVELOPMENTS

SGS is committed to the MMI® technology. With the development of the ICP-MS DRC II™, we have been able to further enhance this analytical approach. The lower detection limits provided by ICP-MS DRC II™ mean that we can better define anomalous targets. For instance, for the exploration of nickel deposits, kimberlites and layered intrusions, low level chrome (1ppb) analysis is an important geological tracer. For uranium exploration, low level vanadium (1ppb) is also an important geological tracer. If either or both of these elements are required for your program, we can analyze your samples for these low chrome and/or vanadium detection limits, using our MMI-ME package.

Other elements such as sulfur, bromine and iodine as well as the lead isotopes can be added to the MMI packages. For these additional elements, please contact Pierrette Prince at pierrette.prince@sgs.com.

MMI-M (Multi-element)**DETECTION LIMITS FOR MMI-M STANDARD PACKAGE**

ELEMENT	UNITS	DL	ELEMENTS	UNITS	DL
Ag	ppb	1	Nb	ppb	0.5
Al	ppm	1	Nd	ppb	1
As	ppb	10	Ni	ppb	5
Au	ppb	0.1	P	ppm	0.1
Ba	ppb	10	Pb	ppb	10
Bi	ppb	1	Pd	ppb	1
Ca	ppm	10	Pr	ppb	1
Cd	ppb	1	Pt	ppb	1
Ce	ppb	5	Rb	ppb	5
Co	ppb	5	Sb	ppb	1
Cr	ppb	100	Sc	ppb	5
Cs	ppb	0.5	Sm	ppb	1
Cu	ppb	10	Sn	ppb	1
Dy	ppb	1	Sr	ppb	10
Er	ppb	0.5	Ta	ppb	1
Eu	ppb	0.5	Tb	ppb	1
Fe	ppm	1	Te	ppb	10
Ga	ppb	1	Th	ppb	0.5
Gd	ppb	1	Ti	ppb	3
Hg	ppb	1	Tl	ppb	0.5
In	ppb	0.5	U	ppb	1
K	ppm	0.1	V		NA
La	ppb	1	W	ppb	1
Li	ppb	5	Y	ppb	1
Mg	ppm	1	Yb	ppb	1
Mn	ppb	10	Zn	ppb	20
Mo	ppb	5	Zr	ppb	5

MMI-ME (Multi-element Enhanced)**MMI-ME ELEMENTS WITH ENHANCED DETECTION LIMITS**

ELEMENT	UNITS	DL	ELEMENTS	UNITS	DL
Ag	ppb	1	Nd	ppb	1
Al	ppm	1	Ni	ppb	5
As	ppb	10	P	ppm	0.1
Au	ppb	0.1	Pb	ppb	10
Ba	ppb	10	Pd	ppb	1
Bi	ppb	1	Pr	ppb	1
Ca	ppm	10	Pt	ppb	1
Cd	ppb	1	Rb	ppb	5
Ce	ppb	5	Sb	ppb	1
Co	ppb	5	Sc	ppb	5
Cr	ppb	1	Se	ppb	2
Cs	ppb	0.5	Sm	ppb	1
Cu	ppb	10	Sn	ppb	1
Dy	ppb	1	Sr	ppb	10
Er	ppb	0.5	Ta	ppb	1
Eu	ppb	0.5	Tb	ppb	1
Fe	ppm	1	Te	ppb	10
Ga	ppb	1	Th	ppb	0.5
Gd	ppb	1	Ti	ppb	3
Hg	ppb	1	Tl	ppb	0.5
In	ppb	0.5	U	ppb	1
K	ppm	0.1	V	ppb	1
La	ppb	1	W	ppb	1
Li	ppb	5	Y	ppb	1
Mg	ppm	1	Yb	ppb	1
Mn	ppb	10	Zn	ppb	20
Mo	ppb	5	Zr	ppb	5
Nb	ppb	0.5			

Other elements that can be added to the MMI-ME package by special request are: S, Br, I and Lead Isotopes.

X-RAY FLUORESCENCE ANALYSIS

X-ray fluorescence spectroscopy has been available to the geochemical industry for over 50 years. It is the classical method for the determination of the major oxides as well as some trace elements. The advantages of using XRF are its precision, rapid analytical time and its multi-element nature. The technique is available in each of our Centres of Excellence. Our calibrations are based on the analysis of international standard reference materials. They accommodate a wide range of sample materials including silicates, raw materials for the steel industry and barite-rich materials and provide accurate and high quality data for a wide range of sample types.

Fusion and pressed pellet are the two industry-standard sample preparation techniques for X-ray fluorescence analysis. Fusion involves melting the sample with flux and casting it into a glass disc. Trace element and sulfidic ore samples require specialized fusions or the pressed pellet technique. Please talk to us to determine the right method for your samples.

For more details, see our publication, Rocks to Results, chapter 4.

WHOLE ROCK ANALYSIS

Whole Rock Analysis is the determination of major elements (reported as "oxides") that make up a sample. This will approximate 100% in non-mineralised samples. SGS offers whole rock analysis using both ICP-AES (ICP95A) or XRF below.

METHOD CODE

FUSION WHOLE ROCK ANALYSIS

XRF76C Majors by Borate Fused Disc / XRF
Al₂O₃, CaO, Cr₂O₃, K₂O, MgO, MnO, Na₂O, P₂O₅, Fe₂O₃, SiO₂,
TiO₂, LOI, V₂O₅, SUM
Lower reporting limit: 0.01%

Additional elements can be added to fused disk analysis.

XRF78S Borate Fusion with XRF for majors
 Al₂O₃, CaO, Cr₂O₃, K₂O, MgO, MnO, Na₂O, P₂O₅, Fe₂O₃, SiO₂,
 TiO₂, LOI, and S as SO₃
 For minors: As, Ba, Cl, Co, Cu, Ni, Pb, Sn, Sr, Ta, V, Zn, Zr

This method is suitable for the analysis of oxide ores like iron ore, silicates, feldspar, gypsum and limestone samples where whole rock analysis by X-ray fluorescence spectrometry is required.

This method is not suitable for samples with a sulphide content > 1%.

This method is not available at all locations.

XRF78R Robotic Sample Preparation and XRF Analysis
 Borate Fusion with XRF for majors
 Al₂O₃, CaO, Cr₂O₃, K₂O, MgO, MnO, Na₂O, P₂O₅, Fe₂O₃, SiO₂,
 TiO₂, LOI, and S as SO₃
 For minors: As, Ba, Cl, Co, Cu, Ni, Pb, Sn, Sr, Ta, V, Zn, Zr

This method is suitable for the analysis of iron ores. The fully integrated robotic system takes the sample from coarse received sample to an analytical result.

This method is not suitable for samples with a sulphide content > 1%.

This method is not available at all locations.

PRESSED PELLETT

XRF75V PRESSED PELLETT, XRF

LIMITS		LIMITS		LIMITS	
Ba	10ppm - 4000ppm	Rb	2ppm - 4000ppm	Y	2ppm - 4000ppm
Nb	2ppm - 4000ppm	Sr	2ppm - 4000ppm	Zr	3ppm - 4000ppm

Additional elements can be added to pressed pellet analysis, please inquire.

PYROSULFATE FUSION XRF77B

Co	Cu	Mn	Ni	W
Cr	Fe	Mo	Pb	Zn

INTERNAL STANDARD ADDITION XRF75F

As	Ta	W
Sb	Th	
Sn	U	

INDIVIDUAL METHODS

SGS offers a variety of methods that cannot be combined into multi-element packages. These include classical wet chemical techniques and specific instruments. This list is only part of the classical method inventory. Limits may vary due to site/location and equipment

METHOD CODE	ELEMENT	METHOD	LIMITS
CLA01A	FeO	Titration	0.10%
CSA01V	C (total)	Furnace/IR	0.005%
CSA02V	CO ₂ (carbonate)	Leach/Furnace/IR	0.01%
CSB02V	CO ₂ (carbonate)	Coulometry	0.05%
CSA03V	C (organic)	Leach/Furnace/IR	0.01%
CSB03V	C (organic)	Coulometry	0.05%
CSA04V	C (inorganic)	Leach/Furnace/IR	0.01%
CSA05V	C (graphitic)	Roast/Coulometry	0.01%
CSA06V	S (total) and C (total)	Furnace / IR	0.005%
CSD06V	S (total)	Furnace / IR	30-75%
CSA07V	SO ₄ ²⁻	Various	0.01%
CSA08V	S ²⁻	Various	0.01%
CSA09V	S (elemental)	Various	0.01%
CLA13V	SO ₄ ²⁻	Gravimetric	10-1%
ISE07A	F-	Specific Ion Electrode	25ppm-10%
CLA04E	Cl-	Titrimetric	0.005%-1%
CLA74V	Cl-	Mercuric Nitrate Titration	25ppm-20000ppm
ISE08B	Cl-	Specific Ion	50ppm
PHY08D	H ₂ O-	Gravimetric	0.1%
PHY09V	H ₂ O+	Penfield	0.1%
CVA20A	Hg	Cold Vapour	5ppb
ISE06T	pH	1-1 ratio	0.01
PHY03V	Specific Gravity	Air Pycnometer	0.01-13
PHY04V	Bulk Density	Immersion	1-10
PHY01K	LOI	Gravimetric @ 1000°C	0.01-100%
PHY02V	LOI	TGA	0.01-100%
CLA10E	Insolubles (acid)	Gravimetric	0.1%
CLA07C	Available lime as CaO		0.01%
CSE04V	Non-sulphide Ni		0.01%
CON08V	Total acid soluble Fe	Titrimetric	0.50%
CON13V	Cu	Short Iodide	2.00%
CON07V	Ni	Dimethylglyoxime	0.05%
CON11V	Pb	EDTA titrimetric	1.00%
CON12V	Zn	EDTA titrimetric	1.00%
ICP05	Bayer-extractable SiO ₂ Al ₂ O ₃ and reactive Si and Al	Caustic bomb	

HYDROGEOCHEMISTRY

The analyses offered in this section are suitable for ground water samples used in mineral exploration, **but NOT for salt water, brines effluent solutions, metal-carrying solutions generated in processing circuits or environmental applications.** Samples such as salt water, effluents or metal-carrying solutions will incur an extra charge and element detection limits may increase. Requests for environmental services will be forwarded to a SGS Environmental Laboratory.

ICP80T

WATER ANALYSIS BY ICP-AES

LIMITS			LIMITS			LIMITS		
Aluminium	Al	50ppb	Iron	Fe	50ppb	Sodium	Na	50ppb
Antimony	Sb	50ppb	Lanthanum	La	10ppb	Strontium	Sr	1ppb
Arsenic	As	30ppb	Lead	Pb	30ppb	Tin	Sn	50ppb
Barium	Ba	10ppb	Magnesium	Mg	50ppb	Titanium	Ti	10ppb
Beryllium	Be	5ppb	Manganese	Mn	5ppb	Tungsten	W	50ppb
Bismuth	Bi	50ppb	Molybdenum	Mo	10ppb	Vanadium	V	10ppb
Cadmium	Cd	10ppb	Nickel	Ni	10ppb	Yttrium	Y	5ppb
Calcium	Ca	50ppb	Phosphorus	P	50ppb	Zirconium	Zr	10ppb
Chromium	Cr	10ppb	Potassium	K	100ppb	Zinc	Zn	5ppb
Cobalt	Co	10ppb	Scandium	Sc	1ppb			
Copper	Cu	5ppb	Silver	Ag	1ppb			

IMS80T

WATER ANALYSIS BY ICP-MS

Antimony	Sb	0.1ppb	Holmium	Ho	0.01ppb	Strontium	Sr	0.01ppb
Arsenic	As	1ppb	Indium	In	0.01ppb	Tantalum	Ta	0.01ppb
Barium	Ba	0.01ppb	Lanthanum	La	0.01ppb	Tin	Sn	0.01ppb
Beryllium	Be	0.1ppb	Lead	Pb	0.01ppb	Tellurium	Te	0.1ppb
Bismuth	Bi	0.01ppb	Lutetium	Lu	0.05ppb	Terbium	Tb	0.01ppb
Cadmium	Cd	0.01ppb	Manganese	Mn	0.1ppb	Thallium	Tl	0.01ppb
Cerium	Ce	0.01ppb	Mercury	Hg	0.2ppb	Thorium	Th	0.01ppb
Cesium	Cs	0.01ppb	Molybdenum	Mo	1ppb	Thulium	Tm	0.01ppb
Chromium	Cr	1ppb	Neodymium	Nd	0.01ppb	Tungsten	W	0.01ppb
Cobalt	Co	0.1ppb	Nickel	Ni	0.1ppb	Uranium	U	0.01ppb
Copper	Cu	0.1ppb	Niobium	Nb	0.01ppb	Vanadium	V	1ppb

Dysprosium	Dy	0.1ppb	Praseodymium	Pr	0.01ppb	Ytterbium	Yb	0.01ppb
Erbium	Er	0.01ppb	Rubidium	Rb	0.1ppb	Yttrium	Y	0.01ppb
Europium	Eu	0.01ppb	Samarium	Sm	0.01ppb	Zinc	Zn	1ppb
Gadolinium	Gd	0.01ppb	Scandium	Sc	0.1ppb	Zirconium	Zr	0.1ppb
Gallium	Ga	0.01ppb	Selenium	Se	1ppb			
Hafnium	Hf	0.01ppb	Silver	Ag	0.01ppb			

IMP80T

PRECIOUS METALS ADD-ON PACKAGE

LIMITS

Gold	Au	0.1ppb
Iridium	Ir	0.1ppb
Palladium	Pd	0.1ppb
Platinum	Pt	0.1ppb
Rhenium	Re	0.1ppb
Rhodium	Rh	0.1ppb
Ruthenium	Ru	1ppb

OPTIONAL WATER DETERMINATIONS

METHOD CODE	ELEMENTS
PHY22V	Total Dissolved Solids (TDS)
ISE06T	pH
ISE07T	Fluoride F ⁻
ISE08T	Chloride Cl ⁻

PROCESS CONTROL ANALYSIS

Metallurgical processes are monitored and controlled by the analysis of samples collected at each stage of processing, thus determining the grade of samples taken from feeds and heads, middlings, concentrates, metals, tails, slags, residues or pregnant solutions. A wide range of analytical techniques are needed to accommodate the varying matrices and complex nature of the samples. Several of the techniques are listed here but this list is certainly not comprehensive. We have extensive experience supporting metallurgical facilities and would be happy to speak with you regarding your specific project requirements.

CUSTOMIZED SPECTROSCOPIC ANALYSIS

The analytical approach for control analysis differs from the standard geochemistry "package" methodology. Instead, we provide customized spectroscopic determinations that can include multiple dilutions and spectral analysis on an element-by-element basis to ensure that the interferences common in complex samples are identified and resolved. A variety of programs are available (see below for a selection), encompassing a wide range of elements including base metals and rare earth elements. Please contact us for more information.

DIGESTIONS

A variety of digestions are used to dissolve control samples for analysis.

DIGESTIONS

Aqua regia digest, finish by ICP-AES, ICP-MS or AAS

Sodium peroxide, potassium hydroxide fusion or lithium metaborate fusion, finish by ICP-AES, ICP-MS or AAS

Strong acid digest, finish by ICP-AES, ICP-MS or AAS

Strong acid digest with fusion of residue, finish by ICP-AES, ICP-MS or AAS

Microwave digest, finish by ICP-AES, ICP-MS or AAS

Selective leaches for speciation

ICP ANALYSIS

MET-ICP42C-30 ELEMENT STRONG ACID (4-ACID) DIGESTION / ICP-AES

Ag	Co	Mo	Sr
Al*	Cr*	Na	Ti*
As*	Cu	Ni	Tl
Ba*	Fe	P	V
Be	K*	Pb	Y
Bi	Li	Sb*	Zn
Ca*	Mg*	Se	
Cd	Mn	Sn*	

*Recovery may not be complete

MET-ICP46C-30 ELEMENT STRONG ACID (4-ACID) DIGESTION WITH A FUSION OF RESIDUE ICP-AES

Ag	Co	Mo	Sr
Al	Cr	Na	Tl
As	Cu	Ni	Ti
Ba	Fe	P	V
Be	K	Pb	Y
Bi	Li	Sb	Zn
Ca	Mg	Se	
Cd	Mn	Sn	

OTHER ANALYSIS

These control assay methods are only a small example of the methods and capabilities available at SGS. A wide variety of other methods are available including fire assay, manual and automated titrations, CVAA mercury analysis, AAS, carbon, sulfur, and chromatography. Fire assay methods often require customized fluxes and finishes. Please contact us if you have any needs in this area – we have lots of expertise to share.

URANIUM EXPLORATION

SGS complies with region specific licensing for transportation, workplace safety and environmental regulations for the safe handling and analysis of NORM samples. The following analytical packages are specifically designed for uranium exploration and may be offered at designated sites.

URANIUM IN LOW MINERALIZED SAMPLES BY AQUA REGIA

IMS14B

36 elements by 3:1 aqua regia / ICP-MS

Suitable for soils and sediments with soluble mineralization

Elements and Ranges (see page 17)

ICM14B

52 elements by 3:1 aqua regia/ICP-OES and ICP-MS

Suitable for soils and sediments with soluble mineralization

Elements and Ranges (see page 17)

URANIUM IN LOW MINERALIZED SOILS USING THE MMI-ME TECHNOLOGY

MMI-ME

Up to 55 elements

Pb isotopes can be added upon request

Elements and limits (see page 30)

URANIUM IN MODERATELY MINERALIZED SAMPLES BY MULTI-ACID DIGEST (NEAR TOTAL)

ICM40B

49 elements by 4 acid digest and ICP-AES/ICP-MS

Suitable for rocks with oxide mineralization

Elements and Ranges (see page 20)

URANIUM IN HIGHLY MINERALIZED SAMPLES BY FUSION AND ICP-MS

IMS95A

31 trace elements by lithium metaborate / ICP-MS

High temperature fusion to dissolve resistant minerals (such as apatite, zircon, monazite and sphene)

Elements and Ranges (see page 25)

URANIUM IN HIGHLY MINERALIZED SAMPLES BY PRESSED PELLET OR FUSION AND XRF (TOTAL)

XRF75F

Pressed pellet with internal standard

Range for U (0.002 – 3)%

Additional elements As, Sb, Sn, Ta, Th, W

XRF76B

Borate fusion with internal standard

Range for U (0.01 – 100)%

Additional elements may be requested

IRON ORE EXPLORATION

SGS has unmatched XRF expertise at many of our operations. Iron ore is common in many mineral forms (hematite, magnetite, goethite, limonite or siderite) and has mineral specific analysis requirements. Borate fusion with XRF analysis is an extremely robust technique for major and minor elemental analysis in complex mineralization and offers highly precise and accurate results for iron ore samples. This method is not suitable for high sulphide materials >1%.

IRON ORE ANALYSIS OF MAJORS AND MINORS BY FUSION-XRF

XRF78S

Borate fusion with XRF for majors - Al_2O_3 , CaO, Cr_2O_3 , K_2O , MgO, MnO, Na_2O , P_2O_5 , Fe_2O_3 , SiO_2 , TiO_2 , V_2O_5 , SUM, LOI and S as SO_3 and minors As, Ba, Cl, Co, Cu, Ni, Pb, Sn, Sr, Ta, V, Zn, Zr

Available at specific sites only

ELEMENTS AND PACKAGES

ELEMENT	SYMBOL	ATOMIC NUMBER										
			MIMI	HYDRIDE	TWO ACID	THREE ACID	FOUR ACID	PEROXIDE FUSION	LITHIUM METABORATE FUSION	XRF	FIRE ASSAY - PB	FIRE ASSAY - NIS
Silver	Ag	47										
Aluminium	Al	13					1					
Arsenic	As	33					2					
Gold	Au	79										
Boron	B	5										
Barium	Ba	56					1					
Beryllium	Be	4										
Bismuth	Bi	83										
Calcium	Ca	20										
Cadmium	Cd	48										
Cerium	Ce	58										
Cobalt	Co	27										
Chromium	Cr	24					1					
Cesium	Cs	55										
Copper	Cu	29										
Dysprosium	Dy	66										
Erbium	Er	68										
Europium	Eu	63										
Iron	Fe	26										
Gallium	Ga	31										
Gadolinium	Gd	64										
Germanium	Ge	32										
Hafnium	Hf	72					1					
Mercury	Hg	80										
Holmium	Ho	67										
Indium	In	49										
Iridium	Ir	77										
Potassium	K	19										
Lanthanum	La	57										
Lithium	Li	3										
Lutetium	Lu	71										
Magnesium	Mg	12										
Manganese	Mn	25					1					
Molybdenum	Mo	42					1					
Sodium	Na	11										

1

Limited Solubility or Precipitation by 4-Acid Digestion

2

Volatile During 4-Acid Digestion

ELEMENT	SYMBOL	ATOMIC NUMBER						PEROXIDE FUSION	LITHIUM METABORATE FUSION	XRF	FIRE ASSAY - PB	FIRE ASSAY - INIS
			MMI	HYDRIDE	TWO ACID	THREE ACID	FOUR ACID					
Niobium	Nb	41				1						
Neodymium	Nd	60										
Nickel	Ni	28										
Osmium	Os	76										
Phosphorous	P	15										
Lead	Pb	82				1						
Palladium	Pd	46										
Praseodymium	Pr	59										
Platinum	Pt	78										
Rubidium	Rb	37										
Rhenium	Re	75										
Rhodium	Rh	45										
Ruthenium	Ru	44										
Sulphur	S	16										
Antimony	Sb	51				1,2						
Scandium	Sc	21										
Selenium	Se	34				2						
Silicon	Si	14										
Samarium	Sm	62										
Tin	Sn	50				1,2						
Strontium	Sr	38										
Tantalum	Ta	73				1						
Terbium	Tb	65										
Tellurium	Te	52				2						
Thorium	Th	90										
Titanium	Ti	22				1						
Thallium	Tl	81										
Thulium	Tm	69										
Uranium	U	92										
Vanadium	V	23										
Tungsten	W	74				1						
Yttrium	Y	39										
Ytterbium	Yb	70										
Zinc	Zn	30										
Zirconium	Zr	40				1						

1 Limited Solubility or Precipitation by 4-Acid Digestion
2 Volatile During 4-Acid Digestion

COMMERCIAL ANALYSIS

SGS laboratories have been performing analytical determinations of pay and penalty metals for decades. SGS' international network of offices offers witnessing, inspection and sampling services at all critical supervision points during transport of your shipment. We use uniform analytical and operational method, follow industry-leading quality assurance and quality control practices, and use standardized templates for data reporting.

The following analyses determine the value of a commodity or product shipment for various purposes:

- 'Load port' or 'pre-shipment' assay data are used by underwriters to insure the approximate dollar value of the shipment. These assays can also be used to calculate partial payment while the parcel or cargo is en-route to the customer. Assay techniques are chosen based on turn-around time and quality.
- Party analyses (also known as commercial settlement assays) determine the quality of a commodity or cargo and thus its value and the payment due. The major or payable elements and all minor or impurity parameters are measured. Party assays use commodity specific methodology and require rigorous quality control steps. Some examples of these methodologies are classical gravimetric (including electroplating), volumetric titration and modern instrumental techniques.
- Umpire assays are used to resolve a dispute between a buyer and seller. Samples of the parcel or cargo are analyzed in triplicate using established methods and quality control protocols to provide the highest level of accuracy and precision.

SGS works for you to protect your interests and reduce your risk. Please contact us for services and pricing specific to your commodity, cargo or product shipment.

GENERAL INFORMATION

SAMPLE DISPATCH

Samples can be submitted to the nearest SGS laboratory or sample preparation facility. Where samples are transported to SGS by a third party, please send notice of shipment dispatch directly to the SGS receiving laboratory. This should have the name of the freight company and date of dispatch. Including waybill numbers, number of pieces and number of samples will ensure that we can help track overdue or missing shipments.

We recommend that all sample submissions be clearly labelled. Sample submissions that are poorly labelled or packaged may incur additional sorting charges. Please ensure that your documents have full details of the analytical package(s) requested and reporting details.

All sample shipments require a chain of custody form or letter with clear instructions to avoid delays. Samples will not be analyzed until we have complete instructions. The minimum information required to proceed is:

- Company name and complete address
- Contact name
- Details for distribution of reports and invoices
- Method codes
- Instructions on sample preparation
- List or range of sample numbers
- Sample disposal / return requirements
- Unusual sample characteristics
- Warning if any samples are potentially hazardous

To eliminate customs delays, use the following information:

- Description of goods, such as "Sample of rock for testing purposes only".
- The receiving SGS laboratory will have the needed customs or quarantine certification to receive your submission promptly. Please contact the laboratory so we can provide the permit details that must be included with the transport documents prior to dispatch.
- Some national authorities require prior notification before samples can be received by certified laboratories. SGS will facilitate this to avoid unnecessary delays in sample receipt.

Together, we can eliminate unnecessary delays and costs by using these sample submission protocols.

SAMPLE STORAGE

Sample pulps will be stored for three months free of charge. Samples will be discarded after three months unless you specifically request their return. Disposal or storage costs may apply.

While SGS will take all reasonable care to protect samples during analysis and storage, the samples shall at all times be at your risk.

REPORTING

All results are reported electronically immediately upon completion. Fax copies can be sent - a fee may apply. Copies of all certificates and invoices are sent via mail to the address you specify. Our QLab data portal, located at <https://qlab.sgs.com>, is accessible over the internet.

LIMS - LABORATORY INFORMATION MANAGEMENT SYSTEM

All SGS laboratories run sophisticated LIMS that facilitate complete tracking of analysis throughout the laboratory. CCLAS EL is our standard. This directly tracks all samples from the time they are received at the preparation facility until they are sent to an SGS Centre of Excellence, analyzed and reported.

RESULT TURNAROUND

Samples are processed at each SGS laboratory as promptly as possible. Sample batches requiring turnaround commitments outside contracted arrangements should be discussed with the appropriate laboratory manager.

FEES AND PAYMENT METHODS

This List of Services outlines the methods SGS Minerals Services offers for geochemical samples. Please contact us for a quote. Geochemical methods are not suitable for the analyses of highly mineralized samples, industrial products or waste. In these cases, separate fees and / or surcharges will apply.

Payment terms are strictly 30 days for approved clients. Interest at 1.5% per month will be levied on overdue accounts. If credit has not been established, advance payment is required.

SGS accepts payment by Visa or MasterCard in many locations. Please inquire at your local laboratory.

SGS reserves the right to change specifications and prices without notice.

Prices are exclusive of consumer taxes and related surcharges. A surcharge of 100% will apply to rush orders needing 24 - 48 hour turn-around given prior notification and acceptability.

A minimum fee is applied to all submissions.

TERMS AND CONDITIONS

SGS Standard General Conditions of Service apply to all services provided. Copies of these can be obtained on our website.

AUDIT POLICY

SGS welcomes client inspection of our analytical processes at ANY time. We appreciate the opportunity to work with you to enhance the analytical service we provide. SGS does however request, if you wish to send an agent to inspect our operations, that the following policy be observed. SGS anticipates that the audit process will be constructive and that it will enhance your confidence in our service.

2ND PARTY AUDIT POLICY

POLICY SCOPE

This policy specifically applies to 2nd party audits, including reviews or inspections of SGS laboratories that "are conducted by parties having an interest in the organization, such as customers, or by other persons on their behalf" (ISO 19011)¹.

This policy has been written for the express purpose of clients, their authorized representatives and SGS laboratory management. It details the practices as per ISO 19011 that are expected by SGS Minerals Services that will allow clients and their representatives access to SGS facilities and people for the purpose of client review. SGS advocates transparency and accountability, and so encourages client review², in accordance with ISO 19011. It is the responsibility of all SGS personnel to follow and adhere to this policy.

CONFIDENTIALITY

SGS requires clients and their representatives to sign a confidentiality agreement prior to review, which must be sighted by the SGS Minerals Services representative on-site. Refer to SGS Geochem Policy 2007-2.

AUDITOR IDENTIFICATION

Client representatives must provide documentation to support their identity and the client that they represent (a copy being retained by SGS). ISO 19011 outlines in detail auditor competence, although SGS is prepared to forsake this if client representatives are able to identify affiliations with professional (geotechnical / scientific) bodies as an indication of their competence and qualification to conduct the review (affiliations being recorded by SGS).

PHOTOGRAPHS AND ACCESS

SGS allows photographs to be taken on the basis that no proprietary equipment, plant, systems, improvements and / or instructions are included (rulings will be made where necessary by the SGS Minerals Services representative). Photographs as with all other documentation must comply with ISO 19011 requirements for "fair representation". SGS will allow unimpeded access to process and records as they relate to that client only. Auditors are to be escorted throughout the process by a senior representative of SGS Minerals Services.

HEALTH AND SAFETY

The auditor / client representative will be required to comply with all SGS OH&S requirements during the visit.

ADVANCE NOTICE

So that the auditor may be appropriately accompanied by a qualified senior representative or SGS Minerals Services appropriate advance notice must be given of a review.

AUDIT OBJECTIVES, SCOPE AND CRITERIA

As per ISO 19011, an audit program / plan that specifies the objectives, scope and criteria of the audit is to be presented to SGS and discussed during an opening meeting. ISO 19011 also requires a closing meeting and a timely copy of the report, that reflects the advice and content provided, so that SGS can understand the issues and importantly make appropriate corrective action. Upon receipt of an audit report, SGS will respond within 14 days.

AUDIT CONDUCT

For conduct of the audit, ISO 19011 requires ethical conduct, fair presentation, due professional care, independence and an evidence-based approach.

REFERENCE

¹ISO 19011: 2002 – Guidelines for quality and / or environmental management encompasses audit and inspection.

²Where review, here and throughout this policy, also encompasses audit and inspection.

CONVERSION FACTORS

US STANDARD TEST SIEVE SERIES

AMERICAN ASTM	TYLER STANDARD SCREEN	INTERNATIONAL
INCH OR SIEVE	INCH OR SIEVE	MILLIMETERS OR MICRONS
1.06 inch	1.05 inch	26.50mm
1	-	25.00
7/8	0.883	22.40
3/4	0.742	19.00
5/8	0.624	16.00
0.53	0.525	13.20
1/2	-	12.50
7/16	0.441	11.20
3/8	0.371	9.50
5/16	2 1/2 mesh	8.00
0.265	3	6.70
1/4	-	6.30
3 1/2 sieve	3.5	5.60
4	4	4.75
5	5	4.00
6	6	3.35
7	7	2.80
8	8	2.36
10	9	2.00
12	10	1.70
14	12	1.40
16	14	1.18
18	16	1.00
20	20	850µm
25	24	710
30	28	600
35	32	500
40	35	425
45	42	355
50	48	300
60	60	250
70	65	212
80	80	180
100	100	150
120	115	125
140	150	106
170	170	90
200	200	75
230	250	63
270	270	53
325	325	45
400	400	38
450	-	32
500	-	25
635	-	20

FREQUENTLY REQUESTED EQUIVALENTS

%	PPM	PPB	GRAMS / METRIC TONNE
1	10000	10000000	10000
0.1	1000	1000000	1000
0.01	100	100000	100
0.001	10	10000	10
0.0001	1	1000	1

CHEMICAL CONVERSION FACTORS

FORMULA			RESULT	FORMULA			RESULT
Al	x	1.889	Al ₂ O ₃	Mn	x	1.291	MnO
Ba	x	1.699	BaSO ₄	MnO	x	1.2255	MnO ₂
Ba	x	1.116	BaO	Mo	x	1.668	MoS ₂
Be	x	2.775	BeO	Na	x	1.348	Na ₂ O
Ca	x	1.399	CaO	Nb	x	1.431	Nb ₂ O ₅
Ca	x	2.497	CaCO ₃	P	x	2.291	P ₂ O ₅
CaO	x	1.78479	CaCO ₃	Pb	x	1.15474	PbS
Cr	x	1.461	Cr ₂ O ₃	Rb	x	1.094	Rb ₂ O
Cu	x	1.25228	Cu ₂ S	Si	x	2.139	SiO ₂
F	x	2.055	CaF ₂	Sn	x	1.27	SnO ₂
Fe	x	1.286	FeO	Sr	x	1.185	SrO
Fe	x	1.43	Fe ₂ O ₃	Ta	x	1.221	Ta ₂ O ₅
Fe	x	1.57414	FeS	Th	x	1.138	ThO ₂
Fe ₂ O ₃	x	0.69943	Fe	Ti	x	1.668	TiO ₂
Fe ₂ O ₃	x	0.89981	FeO	U	x	1.179	U ₃ O ₈
Fe ₂ O ₃	x	1.10101	FeS	V	x	1.785	V ₂ O ₅
K	x	1.205	K ₂ O	W	x	1.261	WO ₃
Mg	x	1.658	MgO	Y	x	1.27	Y ₂ O ₃
Mg	x	3.46908	MgCO ₃	Zr	x	1.351	ZrO ₂
MgO	x	2.09176	MgCO ₃	Zn	x	1.49044	ZnS

DRILL CORE SPECIFICATION

	DIAMETER		VOLUME LENGTH	
	(MM)	(INCH)	M ³ X10 ⁻³ / M	INCH ³ / FOOT
AQ	27.0	1.062	0.57	10.6
TT	35.0	1.378	0.96	17.8
BQ	36.4	1.433	1.04	19.3
NQ	47.6	1.875	1.78	33.1
HQ	63.5	2.500	3.17	58.9
BQ3	33.5	1.320	0.88	16.4
NQ3	45.1	1.775	1.60	29.7
HQ3	61.1	2.406	2.93	54.6
PQ3	83.1	3.270	5.43	100.8

CONVERSION FACTORS

	TROY OUNCES PER				
	PARTS PER MILLION (PPM)	PARTS PER BILLION (PPB)	METRIC TONNE	SHORT TON	LONG TON
1 Gram / MT	1	1000	0.03215	0.02917	31.104
1 Troy oz / short ton	34.286	34.286	1.1023	1	1.2

SGS MINERALS SERVICES DIRECTORY

GEOCHEMISTRY CONTACTS

AUSTRALIA

KALGOORLIE

37 Vivian Street, Boulder, WA 6432

Tel: + 61 (0)8 9093 1066

Fax: + 61 (0)8 9093 1204

Email: au.kalgoorlielab@sgs.com

Services Available: Fire Assay Au and Accelerated CN Leach

LEONORA

Lot 97 Otterburn Street, Leonora, WA 6438

Tel: + 61 (0)8 9037 6007

Fax: + 61 (0)8 9037 6233

Email: au.leonorlab@sgs.com

Services Available: Fire Assay Au

PERTH

10 Reid Road, Newburn WA 6105

Tel: + 61 (0)8 9373 3500

Fax: + 61 (0)8 9373 3668

Email: au.newburnlab@sgs.com

Services Available: Base Metals AAS, Aqua Regia Au, BLEG, ACL, Fire Assay Pb collection (Au, PGE), Flame and Graphite Furnace AAS, XRF, ICP-AES, ICP-MS, MMITM, Instrumental S and C, Classical Techniques. Registered Quarantine Laboratory

TOWNSVILLE

50 Leyland Street, Garbutt, QLD 4814

Tel: + 61 (0)7 4725 2311

Fax: + 61 (0)7 4779 7947

Email: au.townsvillelab@sgs.com

Services Available: Base Metals – Flame AAS, Hydride AAS, ICP-AES, Au – Aqua Regia Flame and Graphite Furnace AAS, BLEG, BLARG, LeachWell, Fire Assay Au Flame and Graphite Furnace AAS and Au, Pt, Pd ICP-AES, Instrumental S and C, Classical Techniques, Industrial Testing and ICP-MS. Registered Quarantine Laboratory

WEST WYALONG

Lot 9, Gelling Street, West Wyalong, NSW 2671

Tel: + 61 (0)2 6972 1211

Fax: + 61 (0)2 6972 0911

Email: au.westwyalonglab@sgs.com

Services Available: AAS Base Metals, Fire Assay Au, S by LECO

BRAZIL

BELO HORIZONTE

SGS Geosol Laboratórios Ltda

Rodovia MG 010, Km 24.5, Bairro Angicos, 33200-000 – Vespasiano – MG

Tel: ++ 55 31 30450200

Fax: ++ 55 31 30450223

Email: alberto.faria@sgsgeosol.com.br

Services Available: Sample Preparation, Fire Assay Au, Pt, Pd AAS/ICP-AES, Aqua Regia Au, BLEG, AAS, ICP-AES, ICP-MS, XRF Whole Rock and Trace Element, Bayer Extractable Al Reactive Si, Leco and Environmental Analysis.

CUIABÁ

SGS Geosol Laboratórios Ltda

Rodovia dos Imigrantes, S/N - Bairro Capão Grande - 78132-400, Cuiabá - MT

Email: alberto.faria@sgsgeosol.com.br

Services Available: Sample Preparation

GOIÂNIA

SGS Geosol Laboratórios Ltda

Av. João Leite, 3209 - Setor Santa Genoveva, 74672-000, Goiânia - GO

Tel: ++ 55 62 3204 2368

Fax: ++ 55 62 3204 2911

Email: lazaro.almeida@go.sgsgeosol.com.br

Services Available: Sample Preparation

PARAUPEBAS

SGS Geosol Laboratórios Ltda

Rua B, 50 - Cidade Nova, 68515-000 - Parauapebas, PA

Tel: ++ 55 94 3346 1773

Fax: ++ 55 94 3346 2301

Email: sgsgeosol.pebas@flexanet.com.br

Services Available: Sample Preparation

BURKINA FASO

OUAGADOUGOU

Zone Industrielle de Kossodo

11 BP:565 Ouagadougou 11

Tel: ++ 226 7020 3999

Mob: ++ 226 5035 8377

Email: patrick.kwaah@sgs.com

Services Available: Fire Assay Au, Acid Digest Au, Limited Base Metals
AAS, Accelerated CN Leach, BLEG Au

CANADA

COCHRANE

1 First Avenue, Cochrane, Ontario P0L 1C0

Tel: + 1 705 272 2559

Fax: + 1 705 272 2670

Email: ken.maley@sgs.com

Services Available: Sample Preparation, Fire Assay Au Gravimetric and ICP-OES

LAKEFIELD

185 Concession Street, Lakefield, Ontario KOL 2H0

Tel: ++ 1 705 652 2000

Fax: ++ 1 705 652 2129

Email: jamie.switzer@sgs.com

Services Available: Base Metals Analysis AAS, ICP-AES, ICP-MS, XRF, XRD,
CVAA, GFAA, Hydride, ISE, Fire Assay Pb, Ni S Collection, Instrumental
S and C and Classical Techniques

RED LAKE

16A Young Street, Red Lake, Ontario POV 2M0

Tel: ++ 1 807 727 2939

Fax: ++ 1 807 727 3183

Email: ken.maley@sgs.com

Services Available: Fire Assay Au Gravimetric and AAS

SUDBURY

1209 O'Neil Drive West, Garson, Ontario P3L 1L5

Tel: ++ 1 705 693 4555

Fax: ++ 1 705 693 1678

Email: ken.maley@sgs.com

Services Available: Sample Preparation, On-Site Sampling, Specific Gravity and Minipal X-ray

TELKWA

1387 Birch Street, Telkwa, British Columbia V0J 2X0

Tel: ++ 1 250 846 9551

Fax: ++ 1 250 846 9551

Email: andrew.pickering@sgs.com

Services Available: Sample Preparation and On-Site Sampling

TORONTO

1885 Leslie Street, Toronto, Ontario M3B 2M3

Tel: ++ 1 416 445 5755

Fax: ++ 1 416 445 4152

Email: bruce.robertson@sgs.com

Services Available: ICP-AES, ICP-MS, (50+ element packages), MMI (Mobile Metal Ions), Fire Assay PGE's, Base Metals and Hydride Elements AAS, Flame and Graphite Furnace AAS, Hg Cold Vapour AAS, CL, F by ISE, NAA Analysis, Instrumental S and C, Classical Techniques and Hydrogeochemistry

VANCOUVER

8282 Sherbrooke Street, Vancouver, British Columbia V5X 4R6

Tel: ++ 1 604 327 3436

Fax: ++ 1 604 327 3423

Email: andrew.pickering@sgs.com

Services Available: ICP-AES, ICP-MS, (50+ element packages), Fire Assay PGE's, Base Metals and Hydride Elements AAS, Hg Cold Vapour AAS, CL, F by ISE, Instrumental S and C and Classical Techniques

CHILE

ANTOFAGASTA

Av. Pedro Aguirre Cerda 7761, Antofagasta

Tel: ++ 56 55 23 8960

Fax: ++ 56 55 29 0719

Email: daniel.pardo@sgs.com

Services Available: Sample Preparation

SGS Verilab S.A., Pedro Aguirre Cerda 8364, Antofagasta

Tel: ++ (56-55) 687000 Ext. 102

Mob: ++ (56-9) 9 8241069

Email: ariel.cerda@sgs.com

Services Available: AAS, ICP and Fire Assay

SANTIAGO

Puerto Madero 9600, Parque Industrial Puerto Santiago, Pudahuel – Santiago

Tel: ++ 56 2 898 9140

Fax: ++ 56 2 747 0144

Email: carlos.gonzalez@sgs.com

Service Available: Sample Preparation, Base Metals Analysis AAS and ICP-AES, Hydride Elements AAS, C and S Analysis, Fire Assay, Hg Cold Vapour, Classical Techniques

CHINA

TIANJIN

No. 41, The 5th Avenue, TEDA, Tianjin, SGS Mansion 300457

Tel: ++ 86 022 6528 8000

Fax: ++ 86 022 2529 9577

Email: sam.song@sgs.com

Services Available: Fire Assay and AAS, ICP-AES, XRF, C and S by LECO, Classical Techniques

COLOMBIA

MEDELLIN

Carrera 54 No. 79AA Sur-40, Bodega 140

Unidad Industrial La Troja, La Estrella, Antioquia

Tel: ++ 57 4 309 4508

Mob: ++ 320 859 7356

Email: juan.velez@sgs.com

Services Available: Sample Preparation, Fire Assay, AAS, ICP-OES, ICP-MS and Classical Chemistry

COTE D'IVOIRE

YAMOUSSOUKRO

Quartier Basilique près de la Radio Catholique, BP 2075 Yamoussoukro

Tel: ++ 225 30 640297

Mob: ++ 225 (0) 8030 9471

Email: SGS_Yamoussoukrolab@sgs.com

Services Available: Sample Preparation

GHANA

TARKWA

Jerusalem Junction, Bankyim, Tarkwa, Western Region, P.O. Box 38, Tarkwa

Tel: ++ 233 (0) 3 1232 0212

Mob: ++ 233 (0) 244 323 404

Email: pieter.devilliers@sgs.com

Services Available: Fire Assay Au, Acid Digest Au, Accelerated CN Leach Au, BLEG Au, Limited AAS Base Metals and Sample Preparation

GUINEA

SIGUIRI

c/o Anglogold Ashanti, Cite de Koron, Siguiri, Republique de Guinea

Tel: ++ 233 772 190 Ext. 1514

Mob: ++ 223 6674 6239

Email: firmin.bado@sgs.com

Services Available: Fire Assay Au, Acid Digest Au, Accelerated CN Leach Au, BLEG Au

INDIA

CHENNAI

1/509A, Old Mahabalipuram Road, Opp to Govt., School

Thoraipakkam, Chennai - 600 096

Tel: ++ 91 44 6669 3095

Mob: ++ 91 95000 28613

Email: balaji.srinivasan@sgs.com

Services Available: Sample Preparation, Fire Assay, AAS, ICP-OES, ICP-MS and XRF

INDONESIA

BALIKPAPAN

Jl Mulawarman No. 45, RT 38 Manggar Balikpapan, Kalimantan Timur, 76116

Tel: + 62 542 772 135

Fax: + 62 542 772 139

Email: yohanes.yullyanto@sgs.com

Services Available: Sample Preparation

JAKARTA

Sentra Industri Terpadu, Pantai Indah Kapuk,

Blok E2 No. 28, 29, 37, 38, Jalan Kamal Muara VII, Jakarta Utara

Mob: + 62 812 1079 512

Email: john.couston@sgs.com

Services Available: Fire Assay Au, Pd, Pt, Base Metals by Flame and Hydride AAS, C, S Analysis, Classical Techniques, Environmental Water Analysis, XRF and ICP-OES

MANADO

Desa Kawangkoan, Kec. Airmadidi, Kab. Dati II Minahasa, Manado, Sulawesi Utara

Tel: + 62 431 892013

Mob: + 62 (0)812 1079 512

Email: john.couston@sgs.com

Services Available: Sample Preparation

MEDAN

Kawasan Industri Medan 2 (KIM 2), Kompleks Medan Mas Karimun, Jl.
Pulau Karimun 2 Blok B-18
Mob: + 62 (0)812 1079 512
Email: john.couston@sgs.com
Services Available: Sample Preparation

LIBERIA

MONROVIA

Somalia Drive, Gardenville
Mob: + 231 (0) 880 885 722
Email: henry.gwadiso@sgs.com
Services Available: Sample Preparation, XRF, Thermogravimetry Analysis,
Screening Analysis and Particle Size Analysis

MALAYSIA

KUANTAN

A3 & A5 Ground Floor, Jalan Gebeng 2/6 Kaw. Perindustrian Gebeng, 26080
Gebeng, Kuantan, Pahang Darul Makmur
Tel: + 6 09 583 3013
Email: calvin.cheah@sgs.com
Services Available: Sample Preparation, Base Metals AAS, Particle Size
Distribution and C & S Analysis

PORT KLANG (KUALA LUMPUR)

Wisma SGS, Lot 603, Leboh Raja Lumu, Kawasan Perindustrian PKNS
Pandamaran, Port Klang, Selangor, 42000
Tel: + 6 03 3165 2320
Email: calvin.cheah@sgs.com
Services Available: Sample Preparation, Fire Assay, Base Metals AAS,
ICP-OES, C & S Analysis and Fertilizer Analysis

MALI

BAMAKO

Zone Industrielle Sotuba, Rue 947,

Porte 213, BPE 2514 Bamako

Tel: + 223 20 21 16 07

Mob: + 223 66 74 62 39

Email: firmin.bado@sgs.com

Services Available: Sample Preparation, Fire Assay and AAS

c/o Morila Gold Mine, BPE 1194, Bamako

Tel: + 223 6965 6149

Mob: + 223 6558 9955

Email: emmanuel.ohenedarko@sgs.com

Services Available: Sample Preparation, Fire Assay, Aqua Regia
and Base Metals

KAYES

Porte 2771, Rue Magdeburg, BP 419, Kayes

Tel: + 223 2152 2393

Mob: + 223 6674 6239

Email: firmin.bado@sgs.com

Services Available: Sample Preparation, Fire Assay Au, Acid Digest Au
and Limited AAS Base Metals

MEXICO

DURANGO

Calle Aluminio y 2da. Selenio, Ciudad Industrial, Durango CP 34208

Tel: + 52 618 814 3883

Fax: + 52 618 814 3881 Ext. 19

Email: leslie.clark@sgs.com

Services Available: Base Metals Analysis AAS, ICP-AES, Fire Assay
and Classical Techniques

NUEVO BALSAS

Emiliano Zapata, #13B, Domicilio Conocido, Nuevo Balsas,
Guerrero CP 40591
Tel: + 52 736 335 4040
Email: leslie.clark@sgs.com
Services Available: Sample Preparation

MONGOLIA

ULAANBAATAR

Barmash Building, Chinggis Avenue, Khan-Uul District, Ulaanbaatar 36
Tel/Fax: ++ 976 11 344 415
Email: simon.ngoon@sgs.com
Services Available: Fire Assay Au, Base Metals and Multi Elements AAS,
ICP-OES, ICP-MS, Full Rock Analysis (XRF), Ion Analyzer (F & Cl) and
LECO C & S

NAMIBIA

SWAKOPMUND

No. 2 Phillips Street, Factory Park, Swakopmund
Tel: ++ 264 (0) 8127 55357
Email: desmond.ortner@sgs.com
Services Available: Sample Preparation

NEW ZEALAND

WAIHI

43 Victoria Street, Waihi 3610, P.O. Box 135, Waihi, 3641
Tel: ++ 64 7 863 8969
Mob: ++ 64 276 414 286
Email: andy.clare@sgs.com
Services Available: Sample Preparation, Fire Assay Au, Acid Digest Au,
Base Metals AAS, ICP-MS and Magnetic Separation on Mineral Sands
(Davis Tube)

WESTPORT

5 Lyttelton Street, Westport, P.O. Box 240, 7866
Mob: + 64 275 284 064
Email: arthur.alloway@sgs.com
Services Available: Sample Preparation, XRF for Major and Trace Elements
and Environmental Analysis

PAPUA NEW GUINEA

LAE

Telikom Site, Mangola St. at Montoro St., Lae

Tel: + 675 7191 8204

Email: paul.anderson@sgs.com

Services Available: Sample Preparation

PERU

CALLAO

Avenue Elmer Faucett, 3348, Callao 1 (Lima)

Tel: + 51 1 517 1900

Fax: + 51 1 574 1600

Email: mariaelena.napanga@sgs.com

Services Available: Fire Assay Au, Pd, Pt, Base Metals by Flame and Hydride AAS, C, S Analysis, Classical Techniques, ICP-AES, ICP-MS and MMI

RUSSIA

CHITA

5 Malaya Street 672014, Chita

Tel: ++ 7 3022 314644

Mob: ++ 7 914 4717667

Email: tatyana.popova@sgs.com

Services Available: Fire Assay Pb, S and C, Base Metals Wet Chemistry, Flame AAS, Cl, F by ISE, ICP-AES (33 elements packages), CN leach and ARD

SOUTH AFRICA

BOOYSENS-JOHANNESBURG

58 Melvill Street, Booysens 2091, P.O. Box 82582, Southdale 2135, Johannesburg

Tel: + 27 11 681 2500

Mob: + 27 (0) 83 601 2867

Email: vusi.thodlana@sgs.com

Services Available: Base Metals, Precious Metals, Silicate Analysis, Multi-element Scans, C and S, Fire Assay Pb/NiS collection, Flame AAS, ICP-AES, ICP-MS, XRF (U, Fe Ore, Mn Ore, Bauxite), LECO, Classical Techniques, Ion Chromatography, Met Testwork, Process Mineralogy, Environmental Testwork, Caustic Fusion for Micro-Diamonds

RUSTENBURG

Warehouse Nr. 69, 72 Kerk Street, Rustenburg 0299,
PostNet Suite 4654, Private Bag X82323, Rustenburg 0300
Tel: ++ 27 (0) 83 321 9579
Email: annamarie.jansen@sgs.com
Services Available: Sample Preparation, Fire-Assay Gravimetric PGMs

TANZANIA

MWANZA

Nyanza Glass Works, Shinyanga Road, P.O. Box 1826, Mwanza
Tel: ++ 255 28 2550836
Fax: ++ 255 28 2550863
Email: sgs.mwanza@sgs.com
Services Available: Fire Assay Au, Acid Digest Au, Accelerated CN
Leach Au, BLEG Au, Limited AAS Base Metals and ICP

TURKEY

ANKARA

12 Profesör Dr.Orhan Işık Cad, Sincan, Ankara, 06935
Mob: + 90 530 263 7754
Email: evgueni.terentiev@sgs.com
Services Available: Fire Assay AA and Gravimetric, ICP-OES,
Trace Elements, Sulphur and Carbon by LECO and Classical Titration

UNITED STATES

ELKO

680 Zaga Way, Elko, Nevada, 89801
Tel: ++ 1 775 738 7900
Fax: ++ 1 775 738 7916
Email: miguel.gonzalez@sgs.com
Services Available: Sample Preparation, Fire Assay and AAS

ZAMBIA

KALALUSHI

SGS Kalalushi Chibuluma Business Park, Kalalushi
Tel: + 260 (212) 730045 / 46
Email: alex.adom@sgs.com
Services Available: Sample Preparation, Base Metals by AAS,
Uranium and Base Metals by XRF, Base Metals Settlement Umpire

METALLURGY CONTACTS

AUSTRALIA

PERTH

431 Victoria Road, Malaga,
Western Australia 6090
Tel: + 61 (0)8 9209 8700
Fax: + 61 (0)8 9209 8701
Email: gary.lonsdale@sgs.com

CANADA

LAKEFIELD

185 Concession Street, Lakefield,
Ontario KOL 2HO
Tel: ++ 1 705 652 2000
Fax: ++ 1 705 652 6365
Email: minerals@sgs.com

TORONTO

1140 Sheppard Ave. West, Unit #6, Toronto,
Ontario M3K 2A2
Tel: ++ 1 416 633 9400
Fax: ++ 1 416 633 2695
Email: minerals@sgs.com

VANCOUVER

Kent Corporate Centre, #50-655 West Kent Avenue North,
Vancouver, British Columbia V6P 6T7
Tel: ++ 1 604 324 1166
Fax: ++ 1 604 324 1177
Email: minerals@sgs.com

CHILE

SANTIAGO

Puerto Madero 9600, Parque Industrial Puerto Santiago,
Pudahuel – Santiago
Tel: ++ 56 2 898 9100
Fax: ++ 56 2 747 0144
Email: reinaldo.barrera@sgs.com

MEXICO

DURANGO

Calle Aluminio y 2da. Selenio,
Ciudad Industrial, 34208 Durango
Tel: ++ 52 618 814 0932
Email: ruben.tirado@sgs.com

RUSSIA

CHITA

5 Malaya Street, 672014, Chita
Tel: ++ 7 (3022) 314644
Mob: ++ 7 (914) 4727618
Email: valery.asalkhanov@sgs.com

SOUTH AFRICA

BOOYSENS-JOHANNESBURG

58 Melvill Street, Booysens 2091, P.O. Box 82582, Southdale 2135,
Johannesburg
Tel: + 27 (0) 11 680 3466
Mob: + 27 (0) 82 894 4165
Email: gavin.martin@sgs.com

UNITED KINGDOM

CORNWALL

Wheal Jane, Truro, Cornwall, TR3 6EE
Tel: ++ 44 0 1872 561577
Fax: ++ 44 0 1872 561703
Email: nigel.macdonald@sgs.com

EXPLORATION SERVICES CONTACTS

CANADA

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10 Boul. de la Seigneurie Est., Suite 203, Blainville, Quebec J7C 3V5
Tel: ++ 1 450 433 1050
Fax: ++ 1 450 433 1048
Email: francois.thibert@sgs.com

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