

GEOCHEM **ANALYSIS**

2009

MINERALS SERVICES

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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 53,000 employees, SGS operates a network of over 1,000 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 breath of expertise and experience which is available from our global network.

USING THIS GUIDE

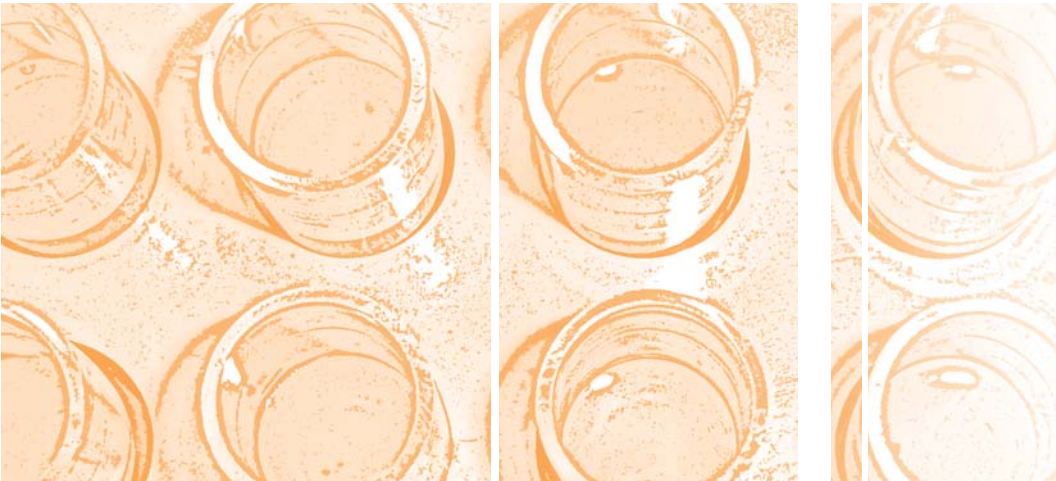
This guide details SGS' core competencies in geochemical analysis and is designed to assist you to choose the analytical methodology that most appropriately fits your needs. It will direct you to the right methodology for the type of sample, element, and species of that element you need. It also helps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

Rocks to Results, also published by SGS, provides geoscientists with an introduction to geoanalysis.

- 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.
- The middle of the guide depicts a Periodic Table of elements 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.



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 intensive quality 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 at www.sgs.com/about_sgs/code_english.htm 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 major regional facilities ISO 9001 certified.

EXPLORATION CLIENTS

Exploration clients are provided with dedicated sample preparation areas in most laboratories. Centres of Excellence dedicated to geochemical analysis are located strategically around the globe in Johannesburg, Lima, Perth, Toronto, Lakefield, Belo Horizonte and Townsville.

The geochemist performs quality, trace, multi-element analysis to target specific support matrices within a particular sample type. We support this by SGS' commitment to advanced technology such as ICP-AES and ICP-MS instrumentation. In acknowledging that every client's needs are unique, SGS aims to support tailored analytical packages with a high-level standardised service offering.

MINING CLIENTS

Mining clients need quality, rapid-turnaround grade control analysis for pit and underground grade control. Mill control analysis can also be SGS' responsibility with routine process sample done with rapid turnaround times.

OTHER SERVICES

SGS also offers services in the area of design, construction and management of on-site laboratories. No matter how remote a project, the services of SGS can be brought to your site. We have over fifty labs operational to attest to this.

SELECTION OF ANALYTICAL METHODS

There are several distinct stages in the evaluation of a resource that range 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 against the needs of the program. For example, grassroots exploration generally requires a geochemical method based on a partial or weak extraction

followed by multi-element analysis. In contrast, analysis in support of a feasibility stage program generally involves 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 program. 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 becomes critical as well as precision. 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 “Q-Mine” (<https://qmine.sgs.com>) for immediate and secure retrieval of their analytical data over the internet. Q-Mine™ allows you to track the progress of your laboratory order 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), Q-Mine™ does not access the LIMS 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.

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 different sample types.

The crushing and pulverizing options available are varied. Your choice can depend on the sample type, size and / or form of the element of interest within the sample matrix. Please consult with our staff for the best possible option for your samples before starting analysis.

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 Crusher or Terminator Crushers
- 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 Pulverize 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 rejects 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 discuss with your local lab manager to get the reporting limits appropriate for your needs.

Precious metals 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 although 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	DESCRIPTION	WEIGHT	LIMITS
GEOCHEM LEVELS			
FAI323	Au by fire assay, ICP-AES finish	30g	Au 0.005 -100ppm Pt 0.01 - 100ppm Pd 0.005 - 100ppm
FAA303	Au by fire assay, AAS finish	30g	Au 0.01 - 100ppm Pt 0.05 - 100ppm Pd 0.01 - 100ppm
FAA505	Au by fire assay, AAS finish	50g	Au 0.01 - 100ppm Pt 0.05 - 100ppm Pd 0.01 - 100ppm
ORE GRADE LEVELS			
FAG303	Gold by fire assay, Gravimetric finish	30g	
FAG323	Silver and gold by lead collection, Fire assay	30g	
FAG505	Gold by fire assay, Gravimetric finish	50g	

TRACE LEVELS

FAA313	Gold by fire assay, AAS finish	30g	5 - 10,000ppb
FAA515	Gold by fire assay, AAS finish	50g	0.005 - 10ppm
F AE505	Gold by fire assay, Solvent extraction, AAS finish	50g	0.001ppm
FAI313	Au by fire assay, ICP-AES finish	30g	Au 1 - 10,000ppb Pt 10 - 10,000ppb Pd 1 - 10,000ppb
FAI515	Au by fire assay, ICP-AES finish	50g	Au 1 - 10,000ppb Pt 10 - 10,000ppb Pd 1 - 10,000ppb
FAM303	Gold by fire assay, ICP-MS finish	30g	1 - 10,000ppb
FAM505	Gold by fire assay, ICP-MS finish	50g	1 - 10,000ppb

SCREENED METALLICS

Gold by screened metallics fire assay consists of:

- 500g screened at 106 µm (or otherwise specified)
- assay of entire plus fraction (>0.03g/t)
- duplicate assay of minus fraction
- calculation and reporting of size fraction weights, coarse and fine fraction gold content and total gold content

FAS30K Screen fire assay at 75µm

FAS31K Screen fire assay at 106µm

SILVER - TRACE LEVELS

AAS12E	Silver by aqua regia digest, AAS	2g	0.3 - 300g/t
AAS21E	Silver by three-acid digest, AAS	2g	0.3 - 300g/t

SILVER - ORE GRADE

FAG313	Silver by lead collection fire assay, Gravimetric finish	30g
FAG323	Silver and gold by lead collection, fire assay, Gravimetric finish	30g

PLATINUM GROUP ELEMENTS

FAI353	Rhodium by fire assay palladium in quart, ICP-AES finish	30g	10 - 500ppb
FAM363	Platinum, Palladium, Rhodium, Ruthenium, Iridium, Osmium by nickel sulphide collection (NiS), ICP-MS finish	30g	Pt 1 - 1000ppb Pd 1 - 1000ppb Rh 1 - 1000ppb Ru 1 - 1000ppb Ir 0.5 - 1000ppb Os 3 - 1000ppb

GOLD BY ACID DIGESTION (AQUA REGIA) - TRACE LEVEL

ARL133	Gold by acid digest, Graphite furnace AAS finish	25g	0.001ppm
ARL155	Gold by acid digest, Graphite furnace AAS finish	50g	0.001ppm
ARE145	Gold by acid digest, DIBK extraction, AAS finish	25g	1 - 200 ppb

GOLD BY ACID DIGESTION (AQUA REGIA) - ORE GRADE LEVEL

ARE133	Gold by acid digest, AAS finish	25g	0.01ppm
ARE155	Gold by acid digest, AAS finish	50g	0.01ppm

CYANIDE EXTRACTABLE GOLD

BLE61K	Active cyanide leach, 24hr leach Solvent extraction, AAS finish	500g	0.01ppm
BLE61N	Active cyanide leach, 24hr leach Solvent extraction, AAS finish	2kg	1ppb
BLE643	Mini-cyanide leach, AAS finish	15g	0.03 - 100ppm
BLL61K	Active cyanide leach, 24hr leach Solvent extraction, graphite furnace finish	500g	0.05ppb
BLL61N	Active cyanide leach, 24hr leach Solvent extraction, graphite furnace finish	2000g	0.05ppb
BLL62N	Static cyanide leach, 24hr leach Solvent extraction, graphite furnace finish	2000g	0.05ppb

ACCELERATED CYANIDE LEACH

LWL69K	Accelerated cyanide leach determination for gold	500g	0.01ppm
LWL69L	Accelerated cyanide leach determination for gold, AAS	800g	0.01 - 1000ppm
LWL69M	Accelerated cyanide leach determination for gold	1000g	0.01ppm

GOLD CYANIDE LIQUOR ANALYSIS

SOL81T	Au in liquor, AAS		0.001ppm
SOL86V	Fire assay, Denver Precipitation		0.02ppm
SOL85V	Free cyanide by titration		5 - 10000mg/L
SOL81X	Solvent extraction, AAS		0.001ppm

GOLD CARBON ANALYSIS

FAA01V	Fire assay 1g, AAS		5 - 50000ppm
ARS12D	Ash, Acid digestion, 1g extraction, AAS finish		2 - 200ppm
FAG01V	Fire assay, Gravimetric finish		5 - 100000ppm

GOLD BULLION ANALYSIS

BUL16A	Aqua regia digestion, Base metals in Bullion		0.1 - 5%
BUL36V	Gold in bullion fire assay, Gravimetric finish	100mg	30 - 99.5%
BUL37V	Silver in bullion fire assay, Gravimetric finish	100mg	0.1 - 30%
BUL38C	Bullion fire assay, Gravimetric finish	500mg	30 - 99.5%

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". This provides a unique suite of elements as well as specific upper and lower reporting limits.

SAMPLE DECOMPOSITION / DIGESTION

This is the most important criteria to consider when making the final decision on the choice of 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

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 using an aqua regia digestion.

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.

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 discuss with your local lab manager to get the reporting limits appropriate for your needs.

The following packages are based on a two-acid digest (a combination of HNO_3 and HCl). After the digestion, the solutions are analyzed by either ICP-AES or ICP-MS or both. We can also analyze these digestions by Hydride AAS to determine the volatile elements. 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 HNO_3 : 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 : HNO_3 . 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 HNO_3 : HCl / 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	1ppm	- 1%	Li	1ppm	- 1%	Sr	0.5ppm	- 5%
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	0.5ppm	- 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	0.1ppm - 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	0.05ppm - 1%
Bi	0.02ppm - 1%	Mg	0.01% - 15%	Th	0.1ppm - 1%
Ca	0.01% - 15%	Mn	5ppm - 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%

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	5ppm - 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%		

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

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 discuss with your local lab manager to get the reporting limits appropriate for your needs.

HYDROFLUORIC, PERCHLORIC, HYDROCHLORIC AND NITRIC ACID DIGEST

Multi-acid digestion is 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 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.

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	- 0.5%
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	0.5ppm	- 1%
Co	1ppm	- 1%	P	0.01%	- 15%	Zr	0.5ppm	- 1%
Cu	0.5ppm	- 1%	Pb	2ppm	- 1%			

Some elements have limited solubility 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 - 5%	Ta	0.05ppm - 1%
Ba	5ppm - 1%	Lu	0.01ppm - 0.1%	Tb	0.05ppm - 1%
Be	0.1ppm - 0.01%	Mg	0.01% - 15%	Te	0.05ppm - 0.05%
Bi	0.04ppm - 1%	Mn	5ppm - 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	0.1ppm - 1%
Cs	5ppm - 0.1%	Ni	0.5ppm - 1%	V	1ppm - 1%
Cr	1ppm - 1%	P	50ppm - 1%	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%		

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	10ppm	-	2%
As	0.01%	-	5%	Cu	10ppm	-	5%	Sb	10ppm	-	2%
Bi	50ppm	-	5000ppm	Fe	0.01%	-	40%	V	50ppm	-	5%
Ca	0.01%	-	40%	Mn	10ppm	-	5%	Zn	10ppm	-	2%
Cd	5ppm	-	5000ppm	Mo	20ppm	-	5%				
Co	10ppm	-	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	500ppm	-	30%	Pb	50ppm	-	2%
Al	250ppm	-	40%	K	0.1%	-	40%	Sb	20ppm	-	10%
As	10ppm	-	2.5%	Li	5ppm	-	2500ppm	Sb	20ppm	-	2%
Bi	50ppm	-	2.5%	Mg	50ppm	-	40%	Ta	50ppm	-	2.5%
Ca	0.01%	-	40%	Mn	10ppm	-	2.5%	Ti	20ppm	-	5%
Cd	5ppm	-	2%	Mo	10ppm	-	2.5%	V	5ppm	-	2.5%
Co	10ppm	-	5%	Na	100ppm	-	40%	Zn	10ppm	-	5%
Cr	10ppm	-	5%	Ni	10ppm	-	5%	Zr	10ppm	-	5%
Cu	10ppm	-	5%	P	0.01%	-	10%				

AAS43B

FOUR-ACID DIGEST AS PER 42S DIGEST BUT FOR SAMPLES WITH HIGHER ELEMENTAL CONCENTRATIONS. AAS FINISH

Ag	500ppm	-	2%	Cr	0.01%	-	40%	Mo	0.02%	-	40%
As	0.02%	-	40%	Fe	0.02%	-	50%	Na	0.01%	-	50%
Bi	0.05%	-	5%	K	0.01%	-	50%	Ni	0.01%	-	50%
Ca	0.01%	-	50%	Mg	0.01%	-	50%	Pb	0.01%	-	20%
Co	0.01%	-	5%	Mn	0.01%	-	40%	Zn	0.01%	-	40%
Cr	0.03%	-	40%								

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 discuss with your local lab manager to get the reporting limits appropriate for your needs.

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.

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
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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 trace elements analyzed via ICP-AES. For 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.

ICP900

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%

MOBILE METAL ION GEOCHEMISTRY - MMI®

SGS is the owner and sole provider of MMI® Technology. We have over 12 years of experience with this technology, and 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. These digest formulas do not dissolve the bound 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 II™).

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

- Few false anomalies
- Focused anomalies
- High repeatability
- Minimal nugget effects

SAMPLE COLLECTION

Sample collection is the most critical aspect of an MMI® program. Samples must be taken at a constant depth (10 - 25 cm) below the organic-inorganic soil interface. This can be in both A and B soil horizons. There is no sample preparation or drying. The analysis is done on a 50g sample and the extracted solution is analysed via ICP-MS or ICP-MS DRC II™, instruments that can provide determinations in the parts per billion range. For detailed instructions for the MMI® sampling protocols and orientation surveys, please visit www.sgs.com/geochem/mmi or contact your local SGS lab.

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 technology. 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 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.

Another advance in the standard MMI-M package allows you to choose either all elements, or specific elements related to your target element. If you need help tailoring an analytical suite for your project, please contact Pierrette Prince at pierrette.prince@sgs.com or visit our website at www.sgs.com/geochem/mmi.

MOBILE METAL ION PROCESS

PACKAGES

MMI-M	Multi-Element Package Cu, Cd, Pb, Zn, Au, Ag, Pd, Co, Ni, U, Rb, Y, Ba, La, Ta, Ce, Pr, Nb, Sm, Gd, Tb, Er, Yb, Ti, Zr, Ca, Mg, Al, Sc, Th, Li, Fe, As, Sb, Bi, Tl, W, Sn, Mo, Te, Cr, Nd and Sr
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DETECTION LIMITS FOR MMI-M STANDARD PACKAGE

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

Select either the standard package or a reduced suite of elements as required. Please refer to your local SGS price list for costs associated with the standard MMI-M package or the reduced suite.

ELEMENTS AND PACKAGES

Element	Symbol	Atomic Number	MMI	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					
Caesium	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	MMI	Hydride	Two Acid	Three Acid	Four Acid	Peroxide Fusion	Lithium Metaborate Fusion	XRF	Fire Assay - Pb	Fire Assay - NiS
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

MMI-ME ELEMENTS WITH ENHANCED DETECTION LIMITS

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

MMI-ME incorporates low level chrome and vanadium.

Low level Cr is important for the exploration of nickel, kimberlites as well as layered intrusions. Vanadium is an important element for uranium exploration.

As with the above standard MMI-M package, the cost structure varies for the full package or a reduced package of elements.

Please refer to your local SGS price list for costs associated with the enhanced MMI-ME full suite or reduced suite.

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.

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 (pg 14) or XRF below.

METHOD CODE

FUSION WHOLE ROCK ANALYSIS

XRF76Z Majors by Borate Fused Disc / XRF
Al₂O₃, CaO, Cr₂O₃, K₂O, MgO, MnO, Na₂O, P₂O₅, Fe₂O₃, SiO₂, TiO₂, LOI
Lower reporting limit: 0.01%

Additional elements can be added to fused disk analysis, please inquire.

PRESSED PELLET

XRF75V PRESSED PELLET, XRF

LIMITS	LIMITS	LIMITS
Ba 20ppm - 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.

INDIVIDUAL METHODS

SGS offers a variety of other methods that cannot be directly combined into multi-element packages. These methods include a variety of classical wet chemical techniques or specific instruments manufactured to measure the element of interest. This list is only part of the classical method inventory, please contact us for more details.

METHOD CODE	ELEMENT	METHOD	LIMITS
CLA01A	FeO	Titration	0.10%
CSA01V	C (total)	Furnace / IR	0.01%
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)	Furnace / IR	0.05%-30%
CSD06V	S (total)	Furnace / IR	30-75%
CSA07V	SO ₄ ²⁻	Leach / Furnace / IR	0.01%
CSA08V	S ²⁻	Leach / Furnace / IR	0.01%
CSA09V	S (elemental)	Leach / Furnace / IR	0.01%
CLA13V	SO ₄ ²⁻	Gravimetric	10-1%
ISE07A	F ⁻	Specific Ion Electrode	20-10%
CLA04E	Cl ⁻	Titrimetric	0.005%-1%
ISE08B	Cl ⁻	Specific Ion	50ppm
PHY08D	H ₂ O ⁻	Gravimetric	0.1%
PHY09V	H ₂ O ⁺	Penfield	0.1%
CVA14C	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 and 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

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

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	

XRF ANALYSIS

X-Ray fluorescence spectroscopy is a powerful tool for the analysis of solid samples for control quality assays. Assays are rapid, precise and accurate for a wide range of concentrations and analytes. Several sample preparation techniques are available, including borate fusion, pyrosulfate fusion and pressed powder. In some time-critical applications, direct reading of samples is also feasible.

BORATE FUSION / XRF

ADDITIONS TO XRF76Z (LISTED ON PAGE 31)

Ba	Nb	Sr	Y
Ce	Nd	Ta	Zr
Co	Ni	Th	
Hf	Pr	U	
La	Sm	W	

PYROSULFATE FUSION XRF

XRF77Z

Co	Cu	Mn	Ni	W
Cr	Fe	Mo	Pb	Zn

XRF75F - INTERNAL STANDARD ADDITION XRF

ELEMENT

As	Ta	W
Sb	Th	
Sn	U	

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.

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 include 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.

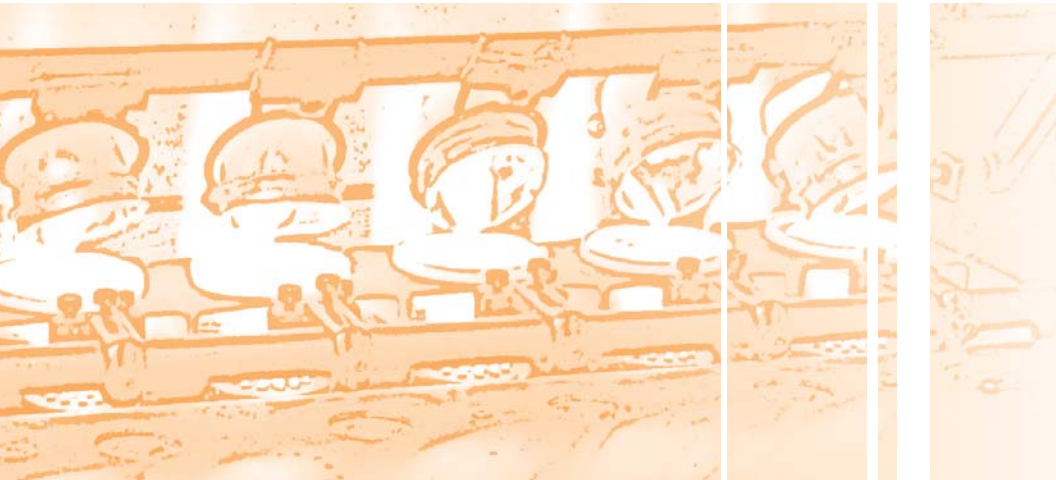
SAMPLE STORAGE

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 Q-Mine data portal, located at <https://qmine.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 at:

http://www.sgs.com/terms_and_conditions.htm

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).

This policy has been written for the express purpose of clients, their authorized representatives and SGS laboratory management. SGS advocates transparency and accountability, and so encourages client review, in accordance with ISO 19011. SGS endorses and will follow the policies of ISO 19011 with respect to second party audits. This provides the standard laboratory access protocols that SGS follows with respect to our premises and our staff to facilitate client review.

CONFIDENTIALITY

SGS requires clients and their representatives sign a confidentiality agreement prior to any review. This document must also be signed by the SGS representative on-site.

AUDITOR IDENTIFICATION

Client representatives must provide documentation to support their own identity and the client that they represent. A copy will be retained by SGS. ISO 19011 outlines in detail criteria for auditor competence, but SGS is prepared to forsake this if client representatives are able to show an affiliation with a professional (geotechnical / scientific) body as an indication of their competence and qualification to conduct the review. Affiliations will be recorded by SGS.

PHOTOGRAPHS AND ACCESS

SGS allows photographs as long as 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 processes and records as they relate to a specific client only. Auditors will be escorted throughout the laboratory by a 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

Advance notice must be given of a review so that a qualified representative of SGS Minerals Services may accompany the auditor.

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 to the client. This will ensure that SGS can understand any issues and, most importantly, make appropriate corrective action. Upon receipt of an audit report, SGS will respond within 14 days.

AUDIT CONDUCT

ISO 19011 requires ethical conduct, fair presentation, due professional care, independence and an evidence-based approach during all audits.

REFERENCE

ISO 19011: 2002 – Guidelines for quality and / or environmental management 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	2.42706	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	3.648	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

SGS MINERALS SERVICES DIRECTORY

GEOCHEMISTRY CONTACTS

ARGENTINA

SAN JUAN

Adolfo Alsina 1382 (1088),
Capital Federal, Buenos Aires
Tel: +54 11 4124 2000 Ext. 2114/2115
Fax: Ext. 109
E-mail: carlos.amigo@sgs.com, gustavo.alaniz@sgs.com
Services Available: Sample preparation

AUSTRALIA

COBAR

9 Railway Parade South, Cobar, NSW 2835
Tel: ++ 61 02 6836 1822
Fax: ++ 61 02 6836 1824
Email: au.cobarlab@sgs.com
Services Available: AAS base metals, fire assay Au

GILLMAN

65 Kapara Road, Gillman S.A. 5013
Tel: ++ 61 08 8447 6833
Fax: ++ 61 08 8447 6442
Email: augillmanlab@sgs.com
Services Available: Sample preparation

KALGOORLIE

37 Vivian Street, Boulder, WA 6432
Tel: ++ 61 08 9093 1066
Fax: ++ 61 08 9093 1204
Email: au.kalgoorlielab@sgs.com
Services Available: Fire assay Au, aqua regia Au and accelerated CN⁻ leach

PERTH

10 Reid Road, Newburn WA 6105
Tel: ++ 61 08 9373 3500
Fax: ++ 61 08 9373 3668
Email: au.welshpoolab@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, MMI instrumental S and C, classical techniques. Registered quarantine laboratory. Metallurgical testing.

TOWNSVILLE

50 Leyland Street, Garbutt, QLD 4814
Tel: ++ 61 07 4725 2311
Fax: ++ 61 07 4779 7947
Email: au.townsvillem@sgs.com
Services Available: Base metals – flame AAS, hydride AAS, ICP-AES, Au: aqua regia flame and graphite furnace AAS, BLEG, BLARG, fire assay Au, Pd Pt: flame, graphite furnace AAS and ICP-AES, instrumental S and C, classical techniques, industrial testing. Registered quarantine laboratory

WEST WYALONG

Lot 9, Gelling Street, West Wyalong, NSW 2671
Tel: ++ 61 02 6972 1211
Fax: ++ 61 02 6972 0911
Email: au.westwyalonglab@sgs.com
Services Available: AAS base metals, fire assay Au, S by Leco

BRAZIL

BELO HORIZONTE

SGS Geosol Laboratorios Ltda
Rodovia MG 010, Km 24.5, Bairro Angicos, 33.200-00 – Vespasiano – MG
Tel: ++ 55 31 3045 0200
Fax: ++ 55 31 3045 0223
Email: alberto.faria@sgsgeosol.com.br
Services Available: Fire assay Au, aqua regia Au and BLEG, Au, Pt, Pd by ICP-AES, XRF whole rock and trace elements, ICP-AES, Leco, AAS, environmental Analysis, caustic fusion diamond extraction

GOIANIA

SGS Geosol Laboratorios Ltda
Av. João Leite, 3209 - St. Sta. Geneveva, CEP 74672-020 Gioiania - GO
Tel: ++ 55 62 3204 2368
Fax: ++ 55 62 3204 2911
Email: goiania@go.sgsgeosol.com.br
Services Available: Sample preparation

ITAITUBA

SGS Geosol Laboratorios Ltda,
Av. Nossa Senhora do Bom Remédio, s/n - Bela Vista, 68180-380 - Itaituba - PA
Tel: ++ 55 93 3518 1183
Email: sgsesol@hotmail.com
Services Available: Sample preparation

PARAUPEBAS

SGS Geosol Laboratorios Ltda
Rua B, 50 -Cidade Nova, 68515-000 - Parauapebas, PA
Tel: ++ 55 94 3346 1773 / 346 6644
Fax: ++ 55 93 3346 2301
Email: sgsesol@hotmail.com
Services Available: Sample preparation

BURKINA FASO

OUAGADOUGOU

Zone Industrielle de Kossodo
11 BP:565 Ouagadougou 11, Burkina Faso
Tel: ++ 226 5035 8377
Fax: ++ 226 5035 8378
Email: stephan.botha@sgs.com
Services Available: Fire assay Au, acid digest Au, limited base metals AAS, accelerated CN⁻ leach, BLEG Au

CANADA

LAKEFIELD

185 Concession Street, Lakefield, Ontario K0L 2H0, Canada

Tel: ++ 1 705 652 2000

Fax: ++ 1 705 652 2129

Email: ken.maley@sgs.com or nicole.mozola@sgs.com

Services Available: Base metals analysis AAS, ICP-AES, ICP-MS, XRF, XRD, CVAA, GFAA, hydride, ISE, fire assay Pb and NiS collection. Instrumental S and C, classical techniques, metallurgical testing, mineralogical testing

TORONTO

1885 Leslie Street, Toronto, Ontario M3B 2M3, Canada

Tel: ++ 1 416 445 5755

Fax: ++ 1 416 445 4152

Email: ca.min@sgs.com

Services Available: Base metals and hydride AAS, flame and graphite furnace AAS, Hg cold vapour AAS, Cl, F by ISE, Mobile Metal Ion, ICP-AES, ICP-MS (50 element packages and hydrogeochemistry), neutron activation analysis, instrumental S and C, classical techniques, fire assay Pb and NiS collection

RED LAKE

16A Young Street, Red Lake, Ontario P0V 2M0, Canada

Tel: ++ 1 807 727 2939

Fax: ++ 1 807 727 3183

Email: ca.rlk@sgs.com, susan_isaac@sgs.com

Services Available: Fire assay Au-gravimetric and AAS

SUDBURY

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

Tel: ++ 1 705 693 4555

Fax: ++ 1 705 693 1678

Email: erin_slack@sgs.com

Services Available: Sample preparation, on-site sampling, specific gravity

CHILE

SANTIAGO

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

Tel: ++ 56 2 747 0140

Fax: ++ 56 2 747 0144

Email: cl.lakefield@sgs.com

Service Available: Base metals analysis AAS and ICP-AES, hydride elements AAS, C and S analysis, fire assay, Hg cold vapour, classical techniques, metallurgical testing, mineralogical analysis

CHINA

KUNMING

101 & 102, First Floor of #C Building, Technological Incubation Park Pioneer Mansion, No. 39,

Yunda Road (W), Economic & Technological Development Zone, Kunming, Yunnan, China

Tel: ++ 86 871 6358 798

Fax: ++ 86 871 6358 799

Email: geochem.kunming@sgs.com

Services Available: Sample preparation

TIANJIN

C, No. 41, Katai Science and Technology Building, The 5th Avenue, TEDA, Tianjin China 300457
Tel: ++ 86 022 2529 3899 / 2529 9576
Fax: ++ 86 022 2529 9577
Email: alex.chong@sgs.com
Services Available: Fire assay and AAS, C and S by Leco, classical techniques

URUMQI

No.6-80 Qidaowan Road, Urumqi, Xinjiang, China, 830017
Tel: ++ 86 991 463 6882
Fax: ++ 86 991 463 6892
Email: geochem.urumqi@sgs.com
Services Available: Sample preparation

XI'AN

Room B1-10101 Standard Factory, No. 39, Chuangye Road, Xinxing Industry Zone, Chang'an District, Xi'an City, Shaanxi Province, 710119
Tel: ++ 86 029 8569 0715
Email: geochem.xian@sgs.com
Services Available: Sample preparation

COLOMBIA

MEDELLIN

Carrera 54 No. 79AA Sur-40, Bodega 140
Unidad Industrial La Troja, La Estrella, Medellin
Tel: ++ 857 4 3094508
Mob: ++ 315 7279618
Services Available: Sample preparation

COTE D'IVOIRE

YAMOUSOUKRO

Quartier Basilique pres de la Radio Catholique, BP 2075 Yamoussoukro
Tel: ++ 225 30 640297
Fax: ++ 225 21 242636
Email: kiki.gyan@sgs.com or sgs_yamoussoukrolab@sgs.com

GHANA

BIBIANI

c/o Central African Gold Ghana Ltd., P.O. Box 98, Old Mill Area, Bibiani, Western Region, Ghana
Tel: ++ 233 31 93092/4
Mob: ++ 233 24 4422589
Email: sgs.bibianilab@sgs.com
Services Available: Fire assay Au, acid digest Au, accelerated CN⁻ leach Au, BLEG Au, limited AAS base metals, sample preparation

TARKWA

Jerusalem Junction, Bankyim, Tarkwa, Western Region, Ghana, P.O. Box 38, Tarkwa, Ghana
Tel: ++ 233 (0) 362 20212
Fax: ++ 233 (0) 362 20289
Email: pieter.devilliers@sgs.com
Services Available: Fire assay Au, acid digest Au, accelerated CN⁻ leach Au, BLEG Au, limited AAS base metals, sample preparation

GUINEA

SIGUIRI

c/o Siguiri Gold Mine (SAG), Cite de Koron, Siguiri, Republique de Guinea
Tel: ++ 233 21 770116 / 120 Ext. 1514
Mob: ++ 224 60 251022 / 224 60 253733
Email: sgssiguiri@anglogoldashanti.com.gn
Services Available: Fire assay Au, acid digest Au, accelerated CN⁻ leach Au, BLEG Au

INDIA

CHENNAI

1/509A, Old Mahabalipuram Road, Opp to Gobt, School
Thoraipakkam, Chennai - 600 096, India
Tel: ++ 91 44 2496 3844 / 2496 3099
Mob: ++ 91 9880228993
Email: setepalli.rao@sgs.com
Services Available: Sample preparation, fire assay, AAS, ICP-AES, ICP-MS

INDONESIA

BALIKPAPAN

Jl Mulawarman No. 45, RT 38/RW 12, Kelurahan Manggar, Kecamatan Balikpapan Timur,
Balikpapan 76116, Kalimantan Timur, Indonesia
Tel: ++ 62 542 772135 / 772136 / 772137
Fax: ++ 62 542 772139
Email: id.balikpapan.min@sgs.com
Services Available: Fire assay Au, Pd, Pt, base metals by flame and hydride AAS, C, S analysis,
classical techniques, environmental water analysis

MALI

BAMAKO

Zone Industrielle Rue 947,
Porte 213, Bamako, Mali
Tel: ++ 223 252 2393
Mob: ++ 223 674 6239
Email: sgs.bamakolab@sgs.com
Services Available: Sample preparation

KAYES

S/C BP 419, Kayes, Mali
Tel: ++ 223 252 2393
Fax: ++ 223 252 2352
Email: kiki.gyan@sgs.com, firmin.bado@sgs.com
Services Available: Fire assay Au, acid digest Au, base metals AAS

MEXICO

DURANGO

Calle Alumino y 2da. Selenio, Ciudad Industrial, 34208 Durango, Mexico
Tel: ++ 52 618 814 3883
Fax: ++ 52 618 814 2739
Email: leslie.clark@sgs.com
Services Available: Minerals analyses, metallurgical testing

MONGOLIA

ULAANBAATAR

Barmash Building, Chinggis Avenue, Khan-Uul District, Ulaanbaatar 36, Mongolia
Tel/Fax: ++ 976 11 344 415
Email: sgs@mbox.mn
Services Available: Fire assay Au, acid digest Au, base metals AAS, BLEG analysis

NAMIBIA

SWAKOPMUND

No.2 Philips Street, Factory Park, Swakopmund, Namibia
Tel: ++ 082 603 8190
Email: brendon.pasco@sgs.com
Services Available: Sample preparation

NEW ZEALAND

WAIHI

43 Victoria Street, Waihi, New Zealand
Tel: ++ 64 7 863 8969
Fax: ++ 64 7 863 6019
Mob: ++ 64 275 706 923
Email: larry.collins@sgs.com
Services Available: Fire assay Au, acid digest Au, base metals AAS, proximate S, calorific value, size analysis on subbituminous coals

PERU

CALLAO

Avenue Elmer Faucett, 3348, Callao 1 (Lima), Peru
Tel: ++ 51 1 517 1970
Fax: ++ 51 1 574 1600
Email: cecilia.palomino@sgs.com
Services Available: Fire assay Au, Pd, Pt, base metals by flame and hydride AAS, C, S analysis, classical techniques, ICP-AES and ICP-MS

RUSSIA

CHITA

5 Malaya Street 672014, Chita, Russia
Tel: ++ 7 3022 314644
Fax: ++ 7 3022 314628
Mob: ++ 7 914 4717667
Email: dmitry.budaev@sgs.com
Services Available: Sample preparation, fire assay ICP-AES/AAS/gravimetric Au, Ag, PGE, aqua regia, BLEG Au, ICP-AES, hydride and cold vapour AAS, C and S leach and Leco, classical techniques, specific gravity, bulk density

SOUTH AFRICA

BARBERTON

2 MacPherson Street, PO Box 648, Barberton 1300, Republic of South Africa
Tel: ++ 27 13 712 6704 / 712 6708
Fax: ++ 27 13 712 6706
Email: sgsbbt@telkomsa.net
Services Available: Fire assay Au, acid digest Au, base metals AAS

BOOYSENS-JOHANNESBURG

58 Melvill Street, Booysens, P.O. Box 82582, Southdale, Johannesburg 2135, Republic of South Africa
Tel: ++ 27 11 680 3466
Fax: ++ 27 11 433 3654
Email: South.Africa@sgs.com
Services Available: Base metals, precious metals, silicate analysis, multi-element analysis, C and S, fire assay Pb, NiS collection, flame AAS, ICP-AES, ICP-MS, XRF, Leco, classical techniques, Ion chromatography, metallurgical testwork, process mineralogy, environmental testwork, caustic fusion for micro-diamonds

RUSTENBURG

Warehouse Nr. 69, Kerk Street, Rustenburg 0299, Republic of South Africa
Tel: ++ 27 0 83 321 9579
Email: annamarie.jansen@sgs.com
Services Available: Sample Preparation

TANZANIA

MWANZA

Nyanza Glass Works, Shinyanga Road, P.O. Box 1826, Mwanza, Tanzania
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

USA

ELKO

680 Zaga Way, Elko, Nevada, 89801 USA
Tel: ++ 1 775 738 7900
Fax: ++ 1 775 738 7916
Email: gregory.firebaugh@sgs.com
Services Available: Sample preparation

VENEZUELA

CARACAS

Avenida Diego Cisneros, Edificio Siemens, Torre Norte,
Piso 4, Los Ruices Caracas, Venezuela
Mob: 51 1 9753 3600
Email: jean.opdebeek@sgs.com
Services Available: Sample preparation

METALLURGY CONTACTS

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431 Victoria Road, Malaga,
Western Australia 6090
Tel: ++ 61 8 9209 8700
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185 Concession Street, Lakefield,
Ontario K0L 2H0, Canada
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1140 Sheppard Ave. West, Unit #6, Toronto,
Ontario M3K 2A2, Canada
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VANCOUVER

Kent Corporate Centre, # 50-655 West Kent Avenue N.,
Vancouver, British Columbia V6P 1E6, Canada
Tel: ++ 1 604 324 1166
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CHILE

SANTIAGO

Puerto Madero 9600, Parque Industrial Puerto Santiago,
Pudahuel – Santiago – Chile
Tel: ++ 56 2 747 0140
Fax: ++ 56 2 747 0144
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UNITED KINGDOM

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WHEN YOU NEED TO BE SURE

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