



ANALYTICAL SERVICES

When you need:

- **UNPARALLELED** network of commercial and mine-site labs
- Uniform **ANALYTICAL** methods
- Unequalled analytical **TECHNOLOGY** to detect deeply buried deposits
- Secure Internet data access at <https://qlab.sgs.com>

Contact **SGS** to be sure

Geochemical sampling and analysis is the basis for many decisions in exploration.

WHEN YOU NEED TO BE SURE of procedures, protocols or lab practice, we hope that you will turn to our free publication.

Rocks to Results - A practical guide to laboratory operations.

Order yours online at www.sgs.com/en/

2019

INDEX

| | |
|---|-----------|
| WELCOME TO SGS | 2 |
| QUALITY POLICY STATEMENT | 5 |
| CODE OF ETHICS | 6 |
| YOUR PARTNERSHIP WITH SGS | 7 |
| ON-SITE TESTING SERVICES | 10 |
| On-Site Labs | 10 |
| Mobile Sample Preparation Units | 10 |
| Core Logging Services | 11 |
| Field Analytical Services and Testing (FAST) | 11 |
| COMMERCIAL TESTING SERVICES | 14 |
| Sample Administration | 15 |
| Sample Preparation | 17 |
| Precious Metals | 25 |
| Exploration-Grade Analysis | 35 |
| Ore-Grade Analysis | 52 |
| Control-Grade Analysis | 56 |
| Commercial Trade Analysis | 62 |
| Select Methods | 63 |
| Ores and Commodities | 68 |
| ELEMENTS AND PACKAGES | 74 |
| MINERALOGY SERVICES | 76 |
| METALLURGY SERVICES | 77 |
| GEOLOGY SERVICES | 78 |
| APPENDICES | 81 |
| Conversion Factors | 81 |
| SGS Minerals Locations (Geochemistry) | 84 |
| SGS Minerals Locations (Metallurgy) | 90 |
| SGS Minerals Locations (Engineering Services) | 92 |

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.

SGS operates a global network of over 2,600 offices and laboratories around the world and employees over 97,000 employees in 300+ countries.

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

The SGS Group has a unique depth and breadth of expertise and experience that can be accessed by clients from our global network.

USING THIS GUIDE

This guide details SGS' core competencies in analytical services 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 you need so you can maximize your analytical dollar.

SGS is currently in the process of updating and modernizing our IT systems and as part of this transformation is implementing a new version of our Laboratory Information Management System. (LIMS). This upgrade represents a significant and generational change to our LIMS software. The new LIMS will be a fully cloud based, globally networked system that is being rolled out across the entire SGS laboratory network. The changes have been driven by major architectural advances in cloud-based technologies together with increasing demand to improve integrations with both internal and external systems. Major enhancements were also needed to future protect and preserve our analytical data and improve system and data security against unauthorized access.

As we transition to the new systems we have needed to standardize our global reference data which has resulted in some changes to LIMS reference information and codes that are used in the configuration and set-up of the system. The updated information and codes can be found within this guide alongside the old codes for your reference.

- This guide is divided into sections based on sample grade, analysis techniques and analyte offerings. The purpose of this guide is to provide the best SGS analytical services available in our core competencies.
- This guide includes an elements and packages table on page 74 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. Regional capabilities can differ throughout the SGS network based on available equipment and expertise. Contact your regional client services representative for details and pricing. Samples can be submitted to any analytical laboratory in the SGS network for forwarding to the most appropriate SGS testing laboratory for that sample type, element and test method. If samples have to be shipped out you will be notified prior to shipping via our quotation and then our final data reports will note where the samples were processed.

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

DEFINITIONS

SGS' analytical services are used by a broad spectrum of clients in the mining sector - from those needing analysis for property assessment during exploration to those needing analysis of metallurgical products, to those requiring commercial analysis for trade transactions. To support these various needs, we have organized our services into categories and have included short explanations concerning the purpose of a test, its advantages and limitations. The categories carry over into our method-coding nomenclature so you can be sure to get the method that is fit for your specific purpose.

Types of analyses offered by SGS include:

- **Exploration-grade analysis** – This class of analysis is intended for large scale reconnaissance exploration programs. Typically, such programs generate rock or soil samples with low metal contents. In general, the frequency of inserted quality control materials is a minimum of 11% and methods with upper measurement limits of about 1% are used.

- **Ore-grade analysis (Mine Grade Control)** – This group of tests is used when analysing medium to high grade mineralized rock or core samples containing percent levels of target elements. The data from these analyses are often used for resource/reserve estimation. In general, the frequency of inserted quality control materials is a minimum of 12% and methods with select elements reaching upper limits of 30%.
- **Control-grade analysis** – Also known as process control, metallurgical support or metal accounting, the data from control-grade analyses are used to monitor or control a metallurgical or mining process. The frequency of inserted quality control materials is a minimum of 18% to a maximum of 120% (process control analysis). Control-grade methods can analyse samples that contain up to 100% of the target element in some cases. High precision and accuracy is achieved using control-grade methodology and can be increased with the number of assays per sample.
- **Commercial-grade analysis** – Commercial-grade analyses provide high precision and accuracy data that can be used to finalise commercial transactions. This data is used for commercial contract settlement or assay exchange (party analysis) and to settle disputes between buyers and sellers of traded commodities (umpire analysis). The frequency of inserted quality control materials is a minimum of 125%. Commercial-grade methods can analyse samples that contain up to 100% of the target element.

ROCKS TO RESULTS

For more information and a background to the topics in this guide, please refer to our publication, Rocks to Results. This book provides geoscientists with an introduction to geoanalysis and is available at www.sgs.com/en/mining/analytical-services/geochemistry.

QUALITY POLICY STATEMENT

SGS is committed to customer satisfaction and 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 geochemical and mineralogical analyses 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 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 your 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 proactively and continuously monitored. It enables us to react promptly to fluctuations in performance.

SGS labs follow a global procedure to select appropriate quality control materials. We define the specified frequency with appropriate acceptance and rejection data criteria for each of our methods. Data are monitored both short term and long term on a continuous basis. Client specific reports are generated with our SLIM (SGS Laboratory Information Management) system and are readily available. Please see our Laboratory Quality Control Summary at www.sgs.com/en/mining/analytical-services/geochemistry for more details on these procedures.

This concern for quality extends to SGS' market attitude. SGS recognises that not all analytical problems can be solved with routine methodology. We value close communication with you, not only to address individual sample situations, but also to address issues confronted by 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 300 SGS minerals analytical 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 us 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 the 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 are trained in it yearly.

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' Centres of Excellence conform to the ISO/IEC 17025 standard and most of our major regional facilities are ISO 9001 certified. SGS provides analytical services for every stage of your project including:

- Exploration
- Developmental Studies
- Mine Production
- Shipment
- Trade
- Mine Closure

ANALYTICAL METHODS AND LIMITS

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 methods based on a partial or weak extraction followed by multi-element analysis. In contrast, analyses 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 at low concentrations, sensitivity and cost effectiveness are usually key when defining an 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 could be acceptable at this stage.

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

Commercial transaction assays require highly precise and accurate assays involving classical methodology. Please see page 62 for details.

In mineral analysis, the concept and application of detection limit is not defined universally nor is it governed by a regulated policy. The terminology used to describe this concept is varied, misused and often confusing. The lower limit (detection limit) is frequently used to market method capabilities but depending upon how this limit is validated and tested, this limit can be misleading. It is important when selecting a method, that all factors are considered.

- What are the elements of interest and their concentration range?
- What is the required precision at or near the concentration of the analyte of interest?
- What is the mineral composition or source of my samples and will this affect the detection limit for the elements of interest?

Method choice should not be exclusively selected based on the lower limit or without consideration of the points above. Limits must be well defined and established using rigorous studies that involve matrix equivalent samples taken through the entire method process and not simply by using a reagent or water blank. Statistical analysis must be used both to estimate and test the lower limit at a suitable confidence level. At SGS, our laboratories take pride in our determination of method/analyte specific limits to ensure that this limit can be confidently projected across a wide range of samples and is fit for purpose.

There are many different analytical methods available in the industry. More detailed descriptions of the common analytes, grades and methods follow in this guide and can help you with method selection. A more exhaustive list of methods is available at your local laboratory. An SGS professional 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.

REPORTING

All results are reported electronically immediately upon completion. Fax and/or hardcopy can be sent - a fee may apply. Copies of all certificates and invoices are sent via PDF email to the address you specify. Our QLab data portal, located at <https://qlab.sgs.com>, is accessible over the internet. Reporting units can be specified as ppb, ppm, g/t, % or oz/tonne (as applicable).

DATA 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 client services personnel.

FEES AND PAYMENT METHODS

This List of Services outlines the range of analytical services and methods offered by SGS. Please contact us for a quote. 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.

ON-SITE TESTING SERVICES

ON-SITE LABS

SGS offers integrated design, construction and management services for on-site laboratories. No matter how remote your operation, SGS services can be deployed to your site and tailored to your specific needs. SGS' on-site laboratory expertise is unparalleled in the industry, with more than 85 on-site analytical laboratories currently in operation. We apply the same principles, procedures and quality standards to our outsourced laboratories as are in practice in our commercial labs.

Allowing SGS to design, staff and operate your lab will ensure that you have at your disposal a full scope of capabilities for the fast turn-around of accurate, reliable data needed to run and optimize your plant operations. Outsourcing of mine-site laboratories allows you to allocate capital and staff more efficiently, concentrate on your core competencies and ensure that the data you base important decisions upon is accurate and consistent. The impartiality of a third party outsourcing partner ensures your results are transparent and meet regulatory reporting requirements.

The SGS Build, Own, Operate, and Maintain (BOOM) initiative is available globally to the minerals industry, and provides clients the opportunity to outsource capital re-quirements, engineering, construction, commissioning, maintenance and operation of non-core facilities to industry specialists.

MOBILE SAMPLE PREPARATION UNITS



SGS offers sample preparation services globally and has many Mobile Sample Preparation Units (MSPU) in some of the most remote locations in the world. Our MSPUs allow you to access our trusted third party sample preparation services in locations that might not otherwise be supported by laboratory facilities. An SGS-designed, staffed and operated MSPU provides

a safe, efficient, and operationally robust in-field service giving you better speed to market and a competitive edge. By choosing our mobile laboratory services, you will:

- Take advantage of SGS's globally recognized technical expertise and laboratory quality management program.
- Reduce shipping delays related to transport of large volumes of samples.
- Benefit from fast turnaround and accurate, reliable geochemical and/or assay data.
- Gain flexibility by choosing the sample preparation protocol that best suits your needs.
- Gain NI 43-101/JORC defensible data with minimal operational demands on your project team.
- Allocate your financial and staff resources more effectively by focusing on the core aspects of your program.
- Pairing our MSPU services with portable technologies like hand-held XRF can provide you with a further enhanced in-field service and faster access to data for more timely decision making.

CORE LOGGING SERVICES

To maximize the return of the considerable investment in obtaining core, SGS provides expert geological exploration services for comprehensive core characterization in gold and precious metals, base metals, iron ore, coal, uranium and industrial minerals. Services may include manual logging by an experienced team of SGS geologists, and / or chemical and mineralogical data obtained by hand held XRF, NIR, or portable XRD units integrated with a MSPU and deployed at the drill site or in an SGS facility. Sampling frequencies can be flexible to project requirements.

FIELD ANALYTICAL SERVICES & TESTING ("FAST")

SGS has responded to the exploration and mining industries' need for improved analytical turnaround by combining a suite of field-based testing technologies that offer short lead-time on results, in order to facilitate faster operational decisions. We can now offer exploration and mining projects

consistent and quality data and FAST turnaround for a large suite of geologically and metallurgically significant analytes.

These robust and portable technologies can be deployed to the field to generate reliable data on a <48 hour TAT to meet the ever-evolving need for rapid analytical data, and have been incorporated into a suite of field-based service packages, which will be accessible to you under the banner of “FAST” – Field Analytical Services & Testing (“FAST”). The packages will be tailored to meet both the technical and financial requirements of the development phase of your project.

The current set of FAST portable analytical technologies generate both chemical and mineralogical data and will be continually updated and augmented with new technologies as they become available in the market and / or new industry testing requirements are identified. In each instance, SGS will complete comprehensive testing of each new technology to ensure that the quality requirements can be achieved, prior to their availability within FAST.

The FAST services currently offered globally are:

- Mobile Preparation Laboratories (MSPU's);
- Minalyze WD-XRF Core Scanning systems;
- Portable XRF analysis systems (pXRF); and
- FTIR analysis systems (FTIR).

EXPLORATION/SOIL PXRF PACKAGE (37 ELEMENTS)

GE PXRF73V

ELEMENTS AND LIMIT(S)

| | | | | | |
|--------------------------------|--------------|-----|---------------|----|--------------|
| Al ₂ O ₃ | 1 - 68% | La | 0.1 - 0.5% | Sn | 0.01 - 1.5% |
| As | 0.05 - 2.0% | MgO | 5 - 70% | Sr | 0.001 - 0.5% |
| Ba | 0.05 - 10.0% | Mn | 0.05 - 45.0% | Ta | 0.01 - 0.2% |
| Bi | 0.005 - 0.3% | Mo | 0.01 - 1.5% | Te | 0.01 - 0.05% |
| Ca | 0.05 - 31.0% | Nb | 0.005 - 0.42% | Th | 0.005 - 0.5% |
| Ce | 0.1 - 4.0% | Ni | 0.005 - 3.0% | Ti | 0.05 - 7.0% |
| Cl | 0.1 - 4.0% | P | 0.05 - 13.0% | U | 0.01 - 0.2% |
| Co | 0.05 - 0.3% | Pb | 0.005 - 4.0% | V | 0.05 - 10.0% |
| Cr | 0.05 - 3.0% | Rb | 0.001 - 0.1% | W | 0.05 - 1.0% |
| Cu | 0.005 - 6.0% | S | 0.01 - 41.0% | Y | 0.001 - 0.1% |
| Fe | 0.05 - 67.0% | Sb | 0.05 - 1.9% | Zn | 0.005 - 1.9% |

| | | | | | |
|------------------|---------------|------------------|--------------|----|--------------|
| Ga | 0.005 - 0.05% | Se | 0.005 - 0.1% | Zr | 0.005 - 2.5% |
| K ₂ O | 0.1 - 15.0% | SiO ₂ | 1 - 100% | | |

For site-specific applications the elemental suites and reporting limits are established as part of the initial calibration phase of the project. SGS' site-specific calibrations and onsite pXRF setups are compliant with the JORC guidelines for the field operation of pXRF. The precision and accuracy of the site-specific calibrated pXRF method is suitable for identifying anomalous samples to aid in exploration target definition, but is not appropriate for use in resource calculations. This technique can also be used for relative metallurgical plant process control and troubleshooting but is not appropriate for metal accounting or final product characterizations.

Precious metals, Au, Ag, Pt, Pd and Rh are not available using this technique as they can be highly biased due to interelement and matrix effects that cannot be removed. Please inquire.

EXPLORATION FTIR PACKAGE

GE FTIR73BULK

MINERALS AND LIMIT(S)

| | | | | | |
|-----------|--------|-------------|--------|-----------|--------|
| K-Felspar | 1-50% | Illite | 1-100% | Siderite | 1-30% |
| Apatite | 1-70% | Kaolin | 1-100% | Smectite | 1-100% |
| Calcite | 1-100% | Petalite | 1-100% | Spodumene | 1-100% |
| Chlorite | 1-100% | Plagioclase | 1-100% | | |
| Dolomite | 1-100% | Quartz | 1-100% | | |

For site-specific applications the minerals and reporting limits are established as part of the initial calibration phase of the project. This FTIR technique is used on pulp type samples.

CORE SCANNING

GE SXRF79C and GE SXRF79G

ELEMENTS AND LIMIT(S)

| | |
|---|-----------------|
| Al ₂ O ₃ , SiO ₂ , K ₂ O, CaO, TiO ₂ , MnO, Fe ₂ O ₃ | *0.1 - 100% |
| SO ₂ , P ₂ O ₃ , Cl | *0.5 - 60% |
| As, Ba, Bi, Ca, Ce | *DL up to 10(*) |

*Lower and upper reporting limits, subject to changes based on sample type, mineralogy, and SGS' custom calibration protocols. Other elements may be available, please inquire.

We have entered into an agreement with Minalyze AB to provide exploration and mining clients with access to the market-leading field deployable Minalyzer CS technology.

This continuous-scan ED-XRF-based technology is:

- Self-contained; for ease of air or road transport;
- Securely shielded; for safe operation;
- Scans entire trays of core / RC chips; for minimal handling of the samples;
- Includes start-of-shift and in-operation calibration; for reliable and consistent data quality and a formal instrument calibration record / audit trail;
- Enables the incorporation of Certified Reference Materials (CRMs) and Site-Specific Reference Materials (SSRMs); for use in site based quality assurance and quality control (QAQC) protocols; and
- Internet connectivity enables remote access for instrument troubleshooting, recalibration events, general data review / supervision, etc.; to support uninterrupted field operation and consistent and reliable data quality.

COMMERCIAL TESTING SERVICES

Most SGS laboratories provide exploration clients with dedicated sample preparation areas. Our Centres of Excellence dedicated to geochemical analysis are located strategically around the globe in Belo Horizonte, Chita, Johannesburg, Lakefield, Lima, Perth and Vancouver. Refer to the directory at the end of this guide for location details.

SGS analysts perform quality, multi-element analyses that target a wide variety of elements in many types of sample matrices. We are firmly committed to advancing the technologies for ICP-AES and ICP-MS.

This commitment ensures we deliver on our promise to provide benchmark-setting quality service. Your needs are unique; therefore we have both tailored analytical packages and high-level custom service offerings.

SAMPLE ADMINISTRATION

SAMPLE SUBMITTAL, COLLECTION AND PICK UP

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

We recommend that all sample submissions be clearly labeled. Sample submissions that are poorly labeled or packaged can incur additional sorting charges. Please ensure that your sample documents have full details of the analytical tests you request and reporting details.

All sample shipments require a sample submittal form or letter with clear instructions to avoid delays. Sample submission forms can be found on our website at www.sgs.com/en/mining/analytical-services/geochemistry. 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, please include the following information:

- Description of goods, such as "Geological sample 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. This includes NORM samples and International Soil Samples. SGS will facilitate this to avoid unnecessary delays in sample receipt. Please contact your local SGS representative.

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

| | |
|-------|------------------------------------|
| PKP01 | Sample collection / pick up |
| LOG10 | Receive, sort Geology Samples |
| LOG11 | Receive, sort Plant Samples |
| LOG12 | Receive, sort Solutions Samples |
| LOG13 | Receive, sort Concentrates Samples |
| WGH10 | Sample weight as received |
| WGH11 | Samples weight after drying |
| WGH12 | Weigh Bullion samples as received |

SAMPLE TRACKING

All SGS laboratories run sophisticated LIMS systems, the SGS SLIM, which facilitates complete tracking of analyses throughout the laboratory. SLIM 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. For more information about this process, please ask your local SGS laboratory for the SGS Chain of Custody document.

SAMPLE RETURN, RETENTION, STORAGE AND DISPOSAL

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, storage and shipping costs may apply.

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

| | |
|-------|---|
| RTN01 | Return, cage (includes transfer of material to crate) |
| RTN02 | Return, bulka bag |
| RTN03 | Return, crate |
| RTN04 | Return, pallet |
| RTN95 | Return of residue samples, per kg |
| RTN96 | Return of pulp samples to client, per kg |
| RTR01 | Retrieval and Handling of samples for reanalysis |
| STO01 | Store, cage, monthly rate |
| STO02 | Store, bulka bag, monthly rate |
| STO03 | Store, crate, monthly rate |
| STO04 | Store, pallet, monthly rate |
| STO05 | handling/retrieval per hour rate |
| DIS10 | Disposal vis Pallet, includes transfer of samples |
| DIS11 | Disposal via Skip, includes transfer of samples |
| DIS12 | Disposal vis Steel Cage, includes transfer of samples |
| DIS13 | Disposal via Bulka Bag, includes transfer of samples |
| DIS14 | Disposal of sample material, per kg rate |

SAMPLE PREPARATION (SIZE REDUCTION)

Sample preparation (also referred to as sample reduction) is the process by which a sample is crushed and pulverized 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 reduction 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 dedicated sample preparation procedures at each of our locations. This involves technologically advanced equipment and, in most cases, physically separated sample processing areas for each sample type.

The crushing and pulverizing options available are varied. Your choice can depend on the sample type and the mineral that hosts 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.

During sample reduction, there are many critical points where sample contamination can occur. One such area arises from the type of equipment used. Unfortunately, during sample reduction, contamination can never be avoided but processes are utilised to keep the level of contamination to a minimum. 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. More information is available in Rocks to Results, Chapter 4.1.

BOWL SELECTION

| BOWL TYPE | SAMPLE CAPACITY | MAIN CONTAMINANT | MINOR CONTAMINANT |
|--------------------------|-----------------|------------------|-------------------|
| Standard mild steel bowl | To 3.5 kg | Fe, Cr | Mo |
| Cr-free steel | 500 g to 1.5 kg | Fe | Mn |
| Zirconia | 100 g | Zr, Hf | Al |
| Tungsten carbide | 150 g | W, Co | Ta |
| Agate | 100 g | | Si |

Note: Not all pulverizing bowl types are available at all locations. Please inquire.

SAMPLE PREPARATION PROCEDURES

DRYING

| | |
|-------|---|
| DRY10 | Sample Drying, 105°C, <5kg |
| DRY11 | Sample Drying, 105°C, 5-7kg |
| DRY12 | Sample Drying, 105°C, 7-10 kg |
| DRY13 | Sample Drying, 105°C, 10-15 kg |
| DRY14 | Sample Drying, 105°C, >15 kg |
| DRY15 | Microwave Sample Drying, 105°C, <5kg |
| DRY16 | Microwave Sample Drying, 105°C, 5-7kg |
| DRY17 | Microwave Sample Drying, 105°C, 7-10kg |
| DRY18 | Microwave Sample Drying, 105°C, 10-15kg |

| | |
|-------|--|
| DRY19 | Microwave Sample Drying, 105°C, >15kg |
| DRY20 | Sample Drying, 60°C, <5kg |
| DRY21 | Sample Drying, 60°C, >5kg, per kg |
| DRY22 | Sample Drying, Room Temp, <5kg |
| DRY23 | Sample Drying, Room Temp, >5kg, per kg |
| DRY24 | Sample Drying, Excessively Wet Samples |
| DRY25 | Oven Drying, 105°C, Carbon Samples |

CRUSHING

| | |
|-------|--|
| CRU10 | Coarse crush 6 mm |
| CRU11 | Crush <5.0 kg, 75% passing 2 mm |
| CRU12 | Crush 5-7 kg, 75% passing 2 mm |
| CRU13 | Crush 7-10 kg, 75% passing 2 mm |
| CRU14 | Crush 10-15 kg, 75% passing 2 mm |
| CRU15 | Crush <15 kg, 75% passing 2 mm by the kg |
| CRU16 | Crush <5.0 kg, 90% passing 2 mm |
| CRU17 | Crush 5-7 kg, 90% passing 2 mm |
| CRU18 | Crush 7-10 kg, 90% passing 2 mm |
| CRU19 | Crush 10-15 kg, 90% passing 2 mm |
| CRU20 | Crush >15 kg, 90% passing 2 mm by the kg |
| CRU21 | CRM Pulverize <5.0 kg, 90% passing 1 mm |
| CRU22 | CRM Pulverize 5-7 kg, 90% passing 1 mm |
| CRU23 | CRM Pulverize 7-10 kg, 90% passing 1 mm |
| CRU24 | CRM Pulverize 10-15 kg, 90% passing 1 mm |
| CRU25 | CRM Pulverize >15 kg, 90% passing 1 mm by the kg |

SPLITTING

| | |
|-------|---|
| SPL10 | Manual Riffle Splitting per kg |
| SPL11 | Cone and Quarter Splitting, per kg |
| SPL12 | Split additional representative samples |
| RSD10 | Rotary Split <5kg |
| RSD11 | Rotary Split 5-7 kg |
| RSD12 | Rotary Split 7-10 kg |
| RSD13 | Rotary Split 10-15 kg |
| RSD14 | Rotary Split >15kg |

SCREENING - Applicable to soils and sediments

| | |
|-------|---|
| SCR10 | Dry Screening to -80mesh (180µm), <2kg |
| SCR11 | Dry Screening to -80mesh (180µm), >2kg |
| SCR12 | Dry screening, Various Meshes, <2 kg |
| SCR13 | Dry screening, Various Meshes, >2 kg |
| SCR14 | Wet screening, 75µm, evaluation of prep |
| SCR15 | Wet screening, various meshes, <2 kg |
| SCR16 | Wet screening, various microns, >2 kg |
| SCR17 | Cyclosizing |
| SCR18 | Metallic/Screening Procedure 100 mesh |
| SCR19 | Metallic/Screening Procedure 150 mesh |
| SCR20 | Wet Screening Desliming |

Note: Wet screening options are available. Please contact your local lab for details.

PULVERIZING

| | |
|-------|--|
| PUL10 | Pulv, CR Steel, 85% 75µm, 250g |
| PUL11 | Pulv, Cr Steel, 85% 75µm, 500g |
| PUL12 | Pulv, Cr Steel, 85% 75µm, 800g |
| PUL13 | Pulv, Cr Steel, 85% 75µm, 1000g |
| PUL14 | Pulv, Cr Steel, 85% 75µm, 3000g |
| PUL15 | Pulv, Cr Steel, 90% 75µm, 250g |
| PUL16 | Pulv, Cr Steel, 90% 75µm, 500g |
| PUL17 | Pulv, Cr Steel, 90% 75µm, 800g |
| PUL18 | Pulv, Cr Steel, 90% 75µm, 1000g |
| PUL19 | Pulv, Cr Steel, 90% 75µm, 3000g |
| PUL20 | Pulv, Zirconia bowl, 50-80g |
| PUL21 | Pulv, Agate/Ceramic Mort & Pest, <100g |
| PUL22 | Pulv, Agate/Ceramic Mort & Pest, <100g |
| PUL23 | Pulv, Agate/Ceramic Ringmill, <100g |
| PUL24 | Pulv, Specified Mesh Size, <500g |
| PUL25 | Pulv, Specified Mesh Size, 500g-1.5kg |
| PUL26 | Pulv, Specified Mesh Size, 1.5kg-3.5kg |
| PUL27 | Disc Grind, 106µm, 500g-1.5kg |

| | |
|-------|--|
| PUL28 | Disc Grind, 106µm, 1.5kg-3.5kg |
| PUL29 | Disc Grind, 106µm, >3.5kg, Per kg |
| PUL30 | Ringmill Preparation, Carbon Sample(s) |
| PUL31 | Hand Preparation, Carbon Sample(s) |
| PUL32 | Pulverization of Concentrates |

Note: Samples can be pulverized in bowls made of other specialized materials if non-metallic preparation is required (e.g. tungsten carbide, zirconia, agate, etc.). Samples can also be pulverized at customer specified grain sizes (i.e. 106 or 120 microns) and % passing requirements. Please inquire.

AUTOMATED SAMPLE PREPARATION

Automated sample preparation is the process by which a sample is crushed, split and pulverised mechanically in a closed system, with no human intervention. Such a system can be connected to an automated fused glass bead machine which produces a sample that is ready for analysis by XRF.

Automated sample preparation has several advantages. First, samples are prepared in a consistent reproducible fashion independent of any human habits or variability. Second, such preparation distances the operator from any hazardous materials that could be present, thus providing a much improved working environment. Third, an automated sample preparation system is much more reproducible. Finally, because the system is computer controlled, preparation parameters are traceable. Thus every sample can be tracked and all parameters pertaining to the sample preparation are recorded.

| | |
|--------|---|
| ROBO10 | Dry, Crush 2 mm, Split 1000 g, Pulv 75µm, <3 kg Robotic Prep |
| ROBO11 | Dry, Crush 2 mm, Split 2000 g, Pulv 75µm, <3 kg Robotic Prep |
| ROBO12 | Dry, Crush 2 mm, Pulv 3000-gram 75µm, <3 kg Robotic Prep |
| ROBO13 | Dry, Crush 2 mm, Split 1000 g, Pulv 75µm, 3-5 kg Robotic Prep |
| ROBO14 | Dry, Crush 2 mm, Split 2000 g, Pulv 75µm, 3-5 kg Robotic Prep |
| ROBO15 | Dry, Crush 2 mm, Split 3000 g, Pulv 75µm, 3-5 kg Robotic Prep |
| ROBO16 | Dry, Crush 2 mm, Split 1000 g, Pulv 75µm, 5-7kg Robotic Prep |
| ROBO17 | Dry, Crush 2 mm, Split 2000 g, Pulv 75µm, 5-7kg Robotic Prep |
| ROBO18 | Dry, Crush 2 mm, Split 3000 g, Pulv 75µm, 5-7kg Robotic Prep |

| | |
|--------|---|
| ROBO19 | Dry, Crush 2 mm, Split 1000 g, Pulv 75µm, 7-10 kg Robotic Prep |
| ROBO20 | Dry, Crush 2 mm, Split 2000 g, Pulv 75µm, 7-10 kg Robotic Prep |
| ROBO21 | Dry, Crush 2 mm, Split 3000 g, Pulv 75µm, 7-10 kg Robotic Prep |
| ROBO22 | Dry, Crush 2 mm, Split 1000 g, Pulv 75µm, 10-15 kg Robotic Prep |
| ROBO23 | Dry, Crush 2 mm, Split 2000 g, Pulv 75µm, 10-15 kg Robotic Prep |
| ROBO24 | Dry, Crush 2 mm, Split 3000 g, Pulv 75µm, 10-15 kg Robotic Prep |

Note: This option is available only at certain locations. Samples can be prepared to a variety of mesh sizes. Please contact your local lab.

MISCELLANEOUS PROCEDURES

| | |
|--------|---|
| WSH78 | CLN11 Barren wash after pulverizing stage |
| WSH79 | CLN10 Barren wash after crushing stage |
| COM10 | Compositing samples, 2 to 1 |
| COM11 | Compositing samples, 3 to 1 |
| COM12 | Compositing samples, 4 to 1 |
| COM13 | Compositing samples, 5 to 1 |
| COM14 | Compositing samples, by the kg |
| RAD01T | Radiation monitoring using scintillation counter |
| PRP70 | Dedicated preparation environment (required for NORM or asbestos-bearing samples) |
| QRT03 | Sample quarantine and handling |
| WST01 | Waste disposal fee |

MOISTURE AND LOSS ON IGNITION (LOI)

Many materials contain volatile components or moisture. SGS has a variety of tests, including moisture (H₂O), loss on ignition (LOI) (at various temperatures) and thermogravimetric analysis (TGA), that provide reliable, qualitative and quantitative analyses of these components.

MOISTURE (H₂O)

| CODE | ELEMENT | LIMIT(S) | DESCRIPTION |
|----------------------|-------------------|-------------|------------------------------------|
| G PHY08D G_PHY03V | H ₂ O- | 0.1 - 100 % | Gravimetric determination at 105°C |
| G PHY09B G_PHY05V | H ₂ O+ | 0.1 - 100 % | Penfield tube |

LOSS ON IGNITION (LOI)

| CODE | ELEMENT | LIMIT(S) | DESCRIPTION |
|----------------------|---------|-------------|-------------------------------------|
| G PHY01K G_PHY01V | LOI | -10 - 100 % | Gravimetric determination at 1000°C |
| G PHY02V G_PHY02V | LOI | -10 - 100 % | Multi-point TGA determinations |

Note: Moisture and LOI can be determined at other temperatures. Please inquire.

SPECIFIC GRAVITY AND BULK DENSITY

Specific gravity is the density of a material relative to water or air. Since rocks are comprised of several distinct mineral phases, they do not have a fixed specific gravity. Instead, a rock's "bulk density" arises as a result of the percentage of each mineral phase in a sample multiplied by the specific gravity of each phase. SGS has extensive experience determining specific gravity and bulk density and we can identify the mineral phases using QEMSCAN®. Specific gravity and bulk density provide key information needed to design your processing flowsheet.

SGS can determine the specific gravity (SG) and bulk density (BD) of rocks, ores and aggregates. International standards are used to control the analysis whether the determination is done using the pycnometer, water and air measurements or the wax method. Such data can yield:

- Precise and accurate identification of mineral composition, including pay, penalty and detrimental metals.
- The most effective processing method.
- Appropriate sizing parameters for processing equipment.
- The exact weight of an ore (often required to calculate shipping and storage costs).

G PHY03V Specific gravity - pycnometer
[G_PHY06V](#)

G PHY05V Specific gravity - volumetric
[G_PHY07V](#)

G PHY14V Specific Gravity - pycnometer bottle
[G_PHY08V](#)

G PHY04V Bulk density - immersion
[G_PHY18V](#)

Note: If samples are porous, PHY04V will require a pre-preparation charge if it is necessary to coat samples with a sealant or wax coating.

PARTICLE SIZE ANALYSIS

Particle size analysis is used to determine the size classification and structural properties of an ore sample or to produce sized fractions for additional testing/analyses. SGS offers particle size analysis by wet screening, dry screening, a combination of both, or laser diffraction.

Wet screening is preferable to dry screening for materials containing a high percentage of clays which tend to agglomerate and thus give erroneous dry screening results. Dry screen tests can be performed on a variety of materials, but the sample must be free flowing and the particles separate (e.g. unagglomerated).

Often wet and dry methods are combined. Wet screening is performed to remove excessive fines then dry screening is performed to remove the oversize. Depending upon the nature of the material, dry screening, wet screening or a combination of both can be used.

Laser diffraction is recommended for very fine grained samples, as it is capable of measuring particle sizes at very low limits (0.02 microns).

Laser diffraction is suitable for use with both wet and dry flows.

G PHY06V Particle size, sieve analysis (dry or wet)
[G_PHY15V](#)

G PHY07V Particle size, laser diffraction
[G_PHY16V](#)

PRECIOUS METALS

Precious metals (gold, silver and platinum group elements) can be analyzed by many techniques. Procedures for gold determination must take into account the sample type, sample concentration, 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 digests and accelerated cyanide leaches can be effective for specific purposes. Similarly, silver can be determined by fire assay or acid digest techniques.

Please discuss your particular circumstance with an SGS chemist so you can choose the most appropriate technique. For more details, see our publication, Rocks to Results, Chapter 4.3.

Some platinum group elements (PGE) can also be determined by lead collection fire assay but this is not recommended. The six element PGE suite is best determined by nickel sulphide collection fire assay and neutron activation or ICP-MS. Sulphide-rich samples can require a reduction in sample weight to fuse properly.

Note: Lower and upper reporting limits of a given method can vary slightly among SGS laboratories due to reagent quality, access to consumables and instrument availability. Please inquire.

GOLD

EXPLORATION-GRADE ANALYSIS

FIRE ASSAY GOLD

| CODE | ELEMENT | LIMIT(S) | DESCRIPTION |
|--|---------|----------------|----------------------------------|
| GE_FAA313 GE_FAA30V5 | Au | 5 - 10,000 ppb | 30 g, Fire assay, AAS finish |
| GE_FAA515 GE_FAA50V5 | Au | 5 - 10,000 ppb | 50 g, Fire assay, AAS finish |
| GE_FAI313* GE_FAI30V5 | Au** | 1 - 10,000 ppb | 30 g, Fire assay, ICP-AES finish |
| GE_FAI515* GE_FAI50V5 | Au** | 1 - 10,000 ppb | 50 g, Fire assay, ICP-AES finish |
| GE_FAI323 GE_FAI31V5 | Au** | 5 - 10,000 ppb | 30 g, Fire assay, ICP-AES finish |

| | | | |
|---|------|----------------|----------------------------------|
| GE FAI525 GE_FAI51V5 | Au** | 5 - 10,000 ppb | 50 g, Fire assay, ICP-AES finish |
| GE FAM313 GE_FAM30V5 | Au** | 1 - 2,000 ppb | 30 g, Fire assay, ICP-MS finish |
| GE FAM515 GE_FAM50V5 | Au** | 1 - 2,000 ppb | 50 g, Fire assay, ICP-MS finish |

Note: *GE FAI313/515 methods use new fire assay pots to achieve lower limits. ** Pt and Pd can be included, refer to page 33.

Gold in soils and/or sediments can be determined by aqua regia digest and DIBK extraction. This is a partial leach and can require a pre-treatment such as roasting if samples contain significant sulphur bearing phases. This gold analytical method has the following advantages:

- Use of large sample sizes (25 g - 50 g) which ensures representative results for materials exhibiting nugget effect.
- The digest used for gold can also be used for a large suite of additional elements.

GOLD BY ACID DIGESTION (AQUA REGIA)

| CODE | ELEMENT | LIMIT(S) | DESCRIPTION |
|---|---------|----------------|--|
| GE ARE145 GE_ARE1V50 | Au | 2 - 200 ppb | 50 g, Aqua regia digest, DIBK extraction, AAS finish |
| GE ARE133 GE_ARE2V25 | Au | 0.02 - 200 ppm | 25 g, Aqua regia digest, DIBK extraction, AAS finish |
| GE ARE155 GE_ARE2V50 | Au | 0.01 - 100 ppm | 50 g, Aqua regia digest, DIBK extraction, AAS finish |
| GE ARM133 GE_ARMV25 | Au* | 1 - 500 ppb | 25 g, Aqua regia digest, ICP-MS finish |
| GE ARM155 GE_ARMV50 | Au* | 1 - 500 ppb | 50 g, Aqua regia digest, ICP-MS finish |

* Note: Refer to page 39 for additional elements that can be determined by this method.

Cyanide leach procedures are used to enhance small gold anomalies during exploration and to monitor gold extraction efficiencies in metallurgical applications.

Bulk Leach Extractable Gold (BLEG) is a cyanide-based partial leach procedure that uses a large sample size (0.5 kg to 5 kg). It is used to enhance small gold anomalies during exploration. The cyanide leachate solution is extracted into an organic solvent and measured by flame AAS

or ICP-MS. Our active cyanide leach packages are available with a variety of sample sizes, detection limits and finishing methods. The mini cyanide leach package is available for smaller sample sizes, allowing for faster TAT than active cyanide leach.

Other elements are also partially extracted with the cyanide leach and can be measured on request.

CYANIDE EXTRACTABLE GOLD

| CODE | ELEMENT | LIMIT(S) | DESCRIPTION |
|---|---------|--------------------|--|
| GE BLE643 GE_MBLA65V30 | Au | 0.1 - 1000 ppm | Hot, 30 g, Mini cyanide leach, ICP-AES or AAS finish |
| GE BLE61K GE_BLE61K | Au | 0.02 - 100 ppm | 500 g, Active cyanide leach, Solvent extraction, AAS finish |
| GE BLE61N GE_BLE61N | Au | 1 ppb - 100 ppm | 2000 g, Active cyanide leach, Solvent extraction, AAS finish |
| GE BLL61K | Au | 0.05 ppb - 100 ppm | 500 g, Active cyanide leach, ICP-MS finish |
| GE BLL61N | Au | 0.05 ppb - 100 ppm | 2000 g, Active cyanide leach, ICP-MS finish |

The Leachwell™ tab is a proprietary product and Leachwell™ is a patented process. Accelerated cyanide leach techniques are used to determine bulk leachable gold in exploration samples using modified cyanide leach (Leachwell™). The large sample is mixed with water and Leachwell™ tabs and tumbled. The gold is extracted into DIBK and analyzed by flame AAS or ICP-MS. Other elements (Cu, Ag, Pb and Zn) are also partially extracted by the cyanide leach and can be measured on request.

ACCELERATED CYANIDE LEACH FOR GOLD

| CODE | ELEMENT | LIMIT(S) | DESCRIPTION |
|---|---------|------------------|--|
| GE LWL69J GE_LWVE69J | Au | 0.01 - 1,000 ppm | 200 g, Accelerated cyanide leach, AAS |
| GE LWL69K GE_LWVE69K | Au | 0.01 - 1,000 ppm | 500 g, Accelerated cyanide leach, AAS |
| GE LWL69L GE_LWVE69L | Au | 0.01 - 1,000 ppm | 800 g, Accelerated cyanide leach, AAS |
| GE LWL69M GE_LWVE69M | Au | 0.01 - 1,000 ppm | 1000 g, Accelerated cyanide leach, AAS |

| | | | |
|-------------------------|----|------------------|--|
| GE LWL69N GE_LWVE69N | Au | 0.01 - 1,000 ppm | 2000 g, Accelerated cyanide leach, AAS |
|-------------------------|----|------------------|--|

ORE-GRADE ANALYSIS

INSTRUMENTAL AND GRAVIMETRIC ANALYSIS

| CODE | ELEMENT | LIMIT(S) | DESCRIPTION |
|--------------------------|---------|-----------------|---|
| GO FAA303 GO_FAA30V10 | Au | 0.01 - 100 ppm | 30 g, Fire assay, AAS finish |
| GO FAA505 GO_FAA50V10 | Au | 0.01 - 100 ppm | 50 g, Fire assay, AAS finish |
| GO FAI303 GO_FAI30V10 | Au | 0.01 - 100 ppm | 30 g, Fire assay, ICP-AES finish |
| GO FAI505 GO_FAI50V10 | Au | 0.01 - 100 ppm | 50 g, Fire assay, ICP-AES finish |
| GO FAG303 GO_FAG30V | Au | 0.5 - 10000 ppm | 30 g, Fire assay, gravimetric finish |
| GO FAG505 GO_FAG50V | Au | 0.5 - 10000 ppm | 50 g, Fire assay, gravimetric finish |
| GO FAG323 GO_FAG32V | Au | 0.01 - 100 ppm | 30 g, Fire assay, AAS finish (Au) gravimetric finish (Ag) |
| | Ag | 10 - 10000 ppm | |
| GO FAG525 GO_FAG52V | Au | 0.01 - 100 ppm | 50 g, Fire assay, AAS finish (Au) gravimetric finish (Ag) |
| | Ag | 10 - 10000 ppm | |
| GO FAG333 GO_FAG33V | Au | 0.5 - 10000 ppm | 30 g, Fire assay, gravimetric finish (Au, Ag) |
| | Ag | 10 - 10000 ppm | |

SCREEN METALLIC GOLD ANALYSIS

Analytical results can be difficult to reproduce using typical sample reduction and fire assay procedures when coarse grained metallic gold is present. To address this, the sample can be analyzed using the screened metallics sample preparation and assaying procedure. This consists of:

- Screening 500g/1000g or client specified of the sample to a defined grain size, usually 75, 106 or 200 microns.
- Weighing the various fractions.
- Assaying the entire plus fraction.

- Weighing and analysing the undersize (usually in duplicate).
- Calculating and reporting of size-fraction weights, coarse and fine fraction gold content and total gold content.
- The finish technique may involve AAS, ICP-AES or gravimetric, depending upon concentration. Limits shown are based on instrument analysis. Gravimetric limits are higher, please contact us for more information.

Note: This technique requires a minimum sample of 500g. This technique can also be used for coarse grained native metals such as platinum, palladium, silver and copper.

SCREENED METALLICS

| CODE | ELEMENT | LIMIT(S) | DESCRIPTION |
|-----------|---------|----------|--|
| GO FAS30K | Au | 0.01 ppm | Au, Ag, screen metallics* (75/106/212), 30g. fire assay, 500g AAS/ICP/Grav |
| | Ag | 10 ppm | |
| GO FAS50K | Au | 0.01 ppm | Au, Ag, screen metallics* (75/106/212), 50g. fire assay, 500g AAS/ICP/Grav |
| | Ag | 10 ppm | |
| GO FAS30M | Au | 0.01 ppm | Au, Ag, screen metallics* (75/106/212), 30g. fire assay, 1000g AAS/ICP/Grav |
| | Ag | 10 ppm | |
| GO FAS50M | Au | 0.01 ppm | Au, Ag, screen metallics* (75/106/212), 50g. fire assay, 1000g AAS/ICP/Grav |
| | Ag | 10 ppm | |
| GO FAS30V | Au | 0.01 ppm | Au, Ag, screen metallics* (75/106/212), 30g. fire assay, >1000g AAS/ICP/Grav |
| | Ag | 10 ppm | |
| GO FAS50V | Au | 0.01 ppm | Au, Ag, screen metallics* (75/106/212), 50g. fire assay, >1000g AAS/ICP/Grav |
| | Ag | 10 ppm | |

Note: *options for screen sizes available. Pt, Pd can be added. Finish technique is based on concentration.

CONTROL AND CONCENTRATE-GRADE ANALYSIS

INSTRUMENTAL AND GRAVIMETRIC ANALYSIS

| CODE | ELEMENT | LIMIT(S) | DESCRIPTION |
|--------------------------|---------|----------|--|
| GC FAA35V GC_FAA35V10 | Au | 0.02 ppm | Variable wt, Fire assay, AAS finish |
| GC FAI34V GC_FAI35V10 | Au | 0.02 ppm | Variable wt, Fire assay, ICP-AES finish |
| GC FAG323 GC_FAG32V | Au | 0.02 ppm | 30 g, Fire assay, AAS finish (Au) |
| | Ag | 10 ppm | 30 g, Fire assay, gravimetric finish (Ag) |
| GC FAG333 GC_FAG33V | Au | 0.5 ppm | 30 g, Fire assay, gravimetric finish (Au, Ag) |
| | Ag | 10 ppm | |

GOLD IN PROCESS SOLUTIONS

| CODE | ELEMENT | LIMIT(S) | DESCRIPTION |
|------------------------|---------|------------|---|
| GC FSA84T GC_FSA84T | Au | >0.01 mg/L | Solution, fire assay, AAS finish |
| GC FSI84T GC_FSI84T | Au | >0.01 mg/L | Solution, fire assay, ICP-AES finish |

GOLD IN CYANIDE LIQUORS

| CODE | ELEMENT | LIMIT(S) | DESCRIPTION |
|------------------------|---------|----------------|---|
| GC SOL81T GC_AAS82T | Au | >0.1 mg/L | CN solution, AAS finish |
| GC SOL81X GC_AAS82X | Au | 0.01 - 50 mg/L | Solvent extraction, DIBK, AAS finish |

GOLD IN CARBON

| CODE | ELEMENT | LIMIT(S) | DESCRIPTION |
|--------------------------------|---------|-----------------|--|
| GC FAA01V GC_FAA01V 100 | Au | 5 - 50,000 ppm | 1-2 g, Fire assay, AAS finish |
| GC ARS12D GC_ACA22D 100V | Au | 5 - 250,000 ppm | 1 g, Ash, acid digest, AAS finish |
| GC FAG01V GC_FAG01V | Au | 5 - 100,000 ppm | 1-5 g, Fire assay, gravimetric finish |

GOLD BULLION

| CODE | ELEMENT | LIMIT(S) | DESCRIPTION |
|------------------------|---------|------------|---|
| GC BUL36V GC_BUL36V | Au | 0.5-99.5% | 250-500 mg, Fire assay, gravimetric finish |
| | Ag | 0.01-99.5% | 250-500 mg, Fire assay, gravimetric finish |

SILVER

EXPLORATION-GRADE ANALYSIS

ACID DIGESTION - INSTRUMENTATION

| CODE | ELEMENT | LIMIT(S) | DESCRIPTION |
|--------------------------|---------|---------------|--------------------------------|
| GE AAS12E GO_AAS22E50 | Ag | 0.3 - 100 ppm | 2 g, 2-Acid digest, AAS finish |
| GE AAS21E GO_AAS33E50 | Ag | 0.3 - 100 ppm | 2 g, 3-Acid digest, AAS finish |
| GE AAS42E GO_AAS42E50 | Ag | 0.3 - 100 ppm | 2 g, 4-Acid digest, AAS finish |

Note: It is recommended that mineralized samples with Ag >30g/t are analyzed using the GO_AAS10D method below. Silver (Ag) can also be analyzed in many multi-element packages. Refer to page 32.

ORE-GRADE ANALYSIS

ACID DIGESTION - INSTRUMENTATION

| CODE | ELEMENT | LIMIT(S) | DESCRIPTION |
|--------------------------|---------|-------------|-------------------------------------|
| GO AAS10D GO_AAS21C50 | Ag | 1 - 300 ppm | 0.5 g, 2-Acid digest, AAS finish |

GRAVIMETRIC ANALYSIS

| CODE | ELEMENT | LIMIT(S) | DESCRIPTION |
|------------------------|---------|----------------|---|
| GO FAG313 GO_FAG32V | Ag | 10 - 10000 ppm | 30 g, Fire assay, gravimetric finish |
| GO FAG515 GO_FAG52V | Ag | 10 - 10000 ppm | 50 g, Fire assay, gravimetric finish |

| | | | |
|------------------------|----|-----------------|--|
| GO FAG323 GO_FAG32V | Au | 0.01 - 100 ppm | 30 g, Fire assay, AAS finish (Au) gravimetric finish (Ag) |
| | Ag | 10 - 10000 ppm | |
| GO FAG333 GO_FAG33V | Au | 0.5 - 10000 ppm | 30 g, Fire assay, gravimetric finish (Au, Ag) |
| | Ag | 10 - 10000 ppm | |
| GO FAG525 GO_FAG52V | Au | 0.01 - 100 ppm | 50 g, Fire assay, AAS finish (Au), gravimetric finish (Ag) |
| | Ag | 10 - 10000 ppm | |

CONTROL AND CONCENTRATE-GRADE ANALYSIS

INSTRUMENTAL AND GRAVIMETRIC ANALYSIS

| CODE | ELEMENT | LIMIT(S) | DESCRIPTION |
|----------------------------|---------|---------------|---|
| GC AAS42V GC_AAS43V100 | Ag | 1 - 1000 ppm | Variable wt, 4-acid digest, AAS finish |
| GC FAG323 GC_FAG32V | Au | 0.02 ppm | 30 g, Fire assay, AAS finish (Au) gravimetric finish (Ag) |
| | Ag | 10 ppm | |
| GC FAG333 GC_FAG33V | Au | 0.5 ppm | 30 g, Fire assay, gravimetric finish (Au, Ag) |
| | Ag | 10 ppm | |
| GC ARS12D GC_ACA22D100V | Ag | 2 - 2,000 ppm | Carbon, 1 g, ash, acid digest, extract, AAS finish |
| GC BUL37V GC_BUL36V | Ag | 0.01 - 99.5% | 250-500 mg, Fire assay, gravimetric finish |

GOLD, PLATINUM, PALLADIUM AND OTHER PRECIOUS METALS

EXPLORATION-GRADE ANALYSIS

GOLD, PLATINUM AND PALLADIUM

| CODE | ELEMENT | LIMIT(S) | DESCRIPTION |
|--------------------------|---------|-----------------|----------------------------------|
| GE FAI313* GE_FAI30V5 | Au | 1 - 10,000 ppb | 30 g, Fire assay, ICP-AES finish |
| | Pt | 10 - 10,000 ppb | |
| | Pd | 1 - 10,000 ppb | |
| GE FAI515* GE_FAI50V5 | Au | 1 - 10,000 ppb | 50 g, Fire assay, ICP-AES finish |
| | Pt | 10 - 10,000 ppb | |
| | Pd | 1 - 10,000 ppb | |
| GE FAM313 GE_FAM30V5 | Au | 1 - 2,000 ppb | 30 g, Fire assay, ICP-MS finish |
| | Pt | 0.5 - 2,000 ppb | |
| | Pd | 0.5 - 2,000 ppb | |
| GE FAM515 GE_FAM50V5 | Au | 1 - 2,000 ppb | 50 g, Fire assay, ICP-MS finish |
| | Pt | 0.5 - 2,000 ppb | |
| | Pd | 0.5 - 2,000 ppb | |
| GE FAI323 GE_FAI31V5 | Au | 5 - 10,000 ppb | 30 g, Fire assay, ICP-AES finish |
| | Pt | 10 - 10,000 ppb | |
| | Pd | 5 - 10,000 ppb | |
| GE FAI525 GE_FAI51V5 | Au | 5 - 10,000 ppb | 50 g, Fire assay, ICP-AES finish |
| | Pt | 10 - 10,000 ppb | |
| | Pd | 5 - 10,000 ppb | |

Note: *GE FAI313/515 methods use new fire assay pots to achieve lower limits.

PLATINUM GROUP ELEMENTS

| CODE | ELEMENT | LIMIT(S) | DESCRIPTION |
|------------------------|---------|----------------|--|
| GE NAA363 GE_NAA363 | Pt | 0.02 - 10 ppm | 30 g, Fire assay nickel sulphide collection, NAA (neutron activation) finish |
| | Pd | 0.02 - 10 ppm | |
| | Rh | 0.005 - 10 ppm | |
| | Ru | 0.05 - 10 ppm | |
| | Ir | 0.001 - 10 ppm | |
| | Os | 0.01 - 10 ppm | |

Note: This method is not available in all SGS laboratories; please contact us for more information.

ORE-GRADE ANALYSIS**GOLD, PLATINUM AND PALLADIUM**

| CODE | ELEMENT | LIMIT(S) | DESCRIPTION |
|--------------------------|---------|----------------|----------------------------------|
| GO FAI303 GO_FAI30V10 | Au | 0.01 - 100 ppm | 30 g, Fire assay, ICP-AES finish |
| | Pt | 0.01 - 100 ppm | |
| | Pd | 0.01 - 100 ppm | |
| GO FAI505 GO_FAI50V10 | Au | 0.01 - 100 ppm | 50 g, Fire assay, ICP-AES finish |
| | Pt | 0.01 - 100 ppm | |
| | Pd | 0.01 - 100 ppm | |

PLATINUM GROUP ELEMENTS

| CODE | ELEMENT | LIMIT(S) | DESCRIPTION |
|---------------------------------------|---------|----------|---|
| GO FAM363 GO NAA363 GO_FAM41V10 | Pt | 0.02 ppm | 30 g, Fire assay nickel sulphide collection, ICP-MS or NAA finish |
| | Pd | 0.02 ppm | |
| | Rh | 0.02 ppm | |
| | Ru | 0.05 ppm | |
| | Ir | 0.04 ppm | |
| | Os | 0.05 ppm | |

Note: Samples can be analyzed by ICP-MS or sent for neutron activation. This method is not available in all SGS laboratories; please contact us for more information.

CONTROL-GRADE ANALYSIS**GOLD, PLATINUM AND PALLADIUM**

| CODE | ELEMENT | LIMIT(S) | DESCRIPTION |
|--------------------------|---------|----------|---|
| GC FAI34V GC_FAI35V10 | Au | 0.02 ppm | Variable wt, Fire assay, ICP-AES finish |
| | Pt | 0.02 ppm | |
| | Pd | 0.02 ppm | |

PLATINUM GROUP ELEMENTS

| CODE | ELEMENT | LIMIT(S) | DESCRIPTION |
|---------------------------------------|---------|----------|---|
| GC FAM363 GC NAA363 GC_FAM41V10 | Pt | 0.02 ppm | 30 g, Fire assay nickel sulphide collection, ICP-MS or NAA finish |
| | Pd | 0.02 ppm | |
| | Rh | 0.02 ppm | |
| | Ru | 0.05 ppm | |
| | Ir | 0.04 ppm | |
| | Os | 0.05 ppm | |

Note: Samples can be analyzed by ICP-MS or sent for neutron activation. This method is not available in all SGS laboratories; please contact us for more information.

EXPLORATION-GRADE ANALYSIS**MULTI-ELEMENT, TRACE ICP-AES AND ICP-MS PACKAGES**

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

SAMPLE DECOMPOSITION / DIGESTION

Sample digestion is the most important parameter to consider when choosing an analytical method. There are several types of digestion available, including:

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

Rocks to Results also provides more details in Chapter 4.2.

Typically, reconnaissance exploration-grade samples (including 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.

Drill-core and rock samples are generally analyzed by multi-acid or fusion digestion, with a multi-element finish. Where metal contents are high (or ore-grade), samples can require further testing or other methods to ensure data is precise and accurate enough for regulatory reporting. Refer to the Ore-Grade Analysis section in this guide.

INSTRUMENTATION

ICP-AES and ICP-MS are the most widely used geoanalytical instrumentation techniques because they yield many elements concurrently. These instruments are widely accepted in the 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 / AQUA REGIA DIGESTION PACKAGES

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 hydride forming elements (Hg, 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 mineral content*.

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

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

NOTE: Requires a minimum sample weight of 0.5g. Detection and upper limits can vary slightly among SGS laboratories because some laboratories may not have access to high purity reagents and consumables and/or they have slight differences in instrumentation. Please talk with your local lab manager to make sure you get the reporting limits you need.

*High sulphide mineral content is defined as over 10%.

TWO ACID / AQUA REGIA DIGESTION / ICP-AES PACKAGE (34 ELEMENTS)

GE_ICP12B GE_ICP22B20 or GE_ICP14B GE_ICP21B20

ELEMENTS AND LIMIT(S)

| | | | | | |
|----|-----------------|----|-----------------|----|-----------------|
| Ag | 2 - 100 ppm* | Hg | 1 - 10000 ppm | Sb | 5 - 10000 ppm |
| Al | 0.01 - 15% | K | 0.01 - 15% | Sc | 0.5 - 10000 ppm |
| As | 3 - 10000 ppm | La | 0.5 - 10000 ppm | Sn | 10 - 10000 ppm |
| Ba | 5 - 10000 ppm | Li | 1 - 10000 ppm | Sr | 0.5 - 10000 ppm |
| Be | 0.5 - 2500 ppm | Mg | 0.01 - 15% | Ti | 0.01 - 15% |
| Bi | 5 - 10000 ppm | Mn | 2 - 10000 ppm | V | 1 - 10000 ppm |
| Ca | 0.01 - 15% | Mo | 1 - 10000 ppm | W | 10 - 10000 ppm |
| Cd | 1 - 10000 ppm | Na | 0.01 - 15% | Y | 0.5 - 10000 ppm |
| Co | 1 - 10000 ppm | Ni | 1 - 10000 ppm | Zn | 1 - 10000 ppm |
| Cr | 1 - 10000 ppm | P | 0.01 - 15% | Zr | 0.5 - 10000 ppm |
| Cu | 0.5 - 10000 ppm | Pb | 2 - 10000 ppm | | |
| Fe | 0.01 - 15% | S | 0.01 - 5% | | |

*Note: The upper limit of 100ppm for Ag is achieved with the GE_ICP14B package only. GE_ICP12B will not fully recover Ag in high concentrations. Refer to the Ag specific methods on page 31.

TWO ACID / AQUA REGIA DIGESTION / ICP-MS PACKAGE (36 ELEMENTS)**GE IMS12B GE_IMS22B20 or GE IMS14B GE_IMS21B20****ELEMENTS AND LIMIT(S)**

| | | | | | |
|----|------------------|----|------------------|----|------------------|
| Ag | 0.01 - 10 ppm | Ga | 0.1 - 10000 ppm | Sb | 0.05 - 10000 ppm |
| Al | 0.01 - 10% | Hg | 0.01 - 100 ppm | Sc | 0.1 - 10000 ppm |
| As | 1 - 10000 ppm | K | 0.01 - 10% | Sn | 0.3 - 1000 ppm |
| Ba | 5 - 10000 ppm | La | 0.1 - 10000 ppm | Sr | 0.5 - 10000 ppm |
| Bi | 0.02 - 10000 ppm | Mg | 0.01 - 15% | Th | 0.1 - 10000 ppm |
| Ca | 0.01 - 15% | Mn | 2 - 10000 ppm | Ti | 0.01 - 10% |
| Cd | 0.01 - 10000 ppm | Mo | 0.05 - 10000 ppm | Tl | 0.02 - 10000 ppm |
| Ce | 0.05 - 1000 ppm | Na | 0.01 - 10% | U | 0.05 - 10000 ppm |
| Co | 0.1 - 10000 ppm | Ni | 0.5 - 10000 ppm | V | 1 - 10000 ppm |
| Cr | 1 - 10000 ppm | P | 0.01 - 1% | W | 0.1 - 10000 ppm |
| Cu | 0.5 - 10000 ppm | Pb | 0.2 - 10000 ppm | Y | 0.05 - 10000 ppm |
| Fe | 0.01 - 15% | Rb | 0.2 - 10000 ppm | Zn | 1 - 10000 ppm |

TWO ACID / AQUA REGIA DIGESTION / COMBINED ICP-AES AND ICP-MS PACKAGE (51 ELEMENTS)**GE ICM12B or GE ICM14B****ELEMENTS AND LIMIT(S)**

| | | | | | |
|----|------------------|----|------------------|----|------------------|
| Ag | 0.01 - 100* ppm | Hg | 0.01 - 10000 ppm | Sc | 0.1 - 10000 ppm |
| Al | 0.01 - 15% | In | 0.02 - 500 ppm | Se | 1 - 1000 ppm |
| As | 1 - 10000 ppm | K | 0.01 - 15% | Sn | 0.3 - 1000 ppm |
| Ba | 5 - 10000 ppm | La | 0.1 - 10000 ppm | Sr | 0.5 - 10000 ppm |
| Be | 0.1 - 100 ppm | Li | 1 - 10000 ppm | Ta | 0.05 - 10000 ppm |
| Bi | 0.02 - 10000 ppm | Lu | 0.01 - 1000 ppm | Tb | 0.02 - 10000 ppm |
| Ca | 0.01 - 15% | Mg | 0.01 - 15% | Te | 0.05 - 1000 ppm |
| Cd | 0.01 - 10000 ppm | Mn | 2 - 10000 ppm | Th | 0.1 - 10000 ppm |
| Ce | 0.05 - 1000 ppm | Mo | 0.05 - 10000 ppm | Ti | 0.01 - 15% |
| Co | 0.1 - 10000 ppm | Na | 0.01 - 15% | Tl | 0.02 - 10000 ppm |
| Cr | 1 - 10000 ppm | Nb | 0.05 - 1000 ppm | U | 0.05 - 10000 ppm |
| Cs | 0.05 - 1000 ppm | Ni | 0.5 - 10000 ppm | V | 1 - 10000 ppm |
| Cu | 0.5 - 10000 ppm | P | 0.01 - 15% | W | 0.1 - 10000 ppm |
| Fe | 0.01 - 15% | Pb | 0.2 - 10000 ppm | Y | 0.05 - 10000 ppm |

| | | | | | |
|----|-----------------|----|------------------|----|-----------------|
| Ga | 0.1 - 10000 ppm | Rb | 0.2 - 10000 ppm | Yb | 0.1 - 100 ppm |
| Ge | 0.1 - 10000 ppm | S | 0.01 - 5% | Zn | 1 - 10000 ppm |
| Hf | 0.05 - 500 ppm | Sb | 0.05 - 10000 ppm | Zr | 0.5 - 10000 ppm |

*Note: The upper limit of 100ppm for Ag is achieved with the GE_ICP14B package only. GE_ICP12B will not fully recover Ag in high concentrations. Refer to the Ag specific methods on page 31.

TWO ACID / AQUA REGIA DIGESTION / HYDRIDE AAS PACKAGE**GE HAS12B or GE HAS14B GE_HAS21B20****ELEMENTS AND LIMIT(S)**

| | | | | | |
|----|---------------|----|---------------|----|---------------|
| As | 0.1 - 500 ppm | Sb | 0.1 - 500 ppm | Te | 0.1 - 500 ppm |
| Bi | 0.1 - 500 ppm | Se | 0.1 - 500 ppm | | |

AQUA REGIA DIGESTION ICP-MS PACKAGE (49 ELEMENTS)**GE ARM133 GE_ARMV25 (25g) or GE ARM155 GE_ARMV50 (50g)****ELEMENTS AND LIMIT(S)**

| | | | | | |
|----|-----------------|----|------------------|----|------------------|
| Ag | 0.02 - 100 ppm | Hg | 0.02 - 1000 ppm | Se | 0.5 - 2500 ppm |
| As | 0.5 - 2000 ppm | Ho | 0.01 - 2000 ppm | Sm | 0.02 - 1000 ppm |
| Au | 1 - 500 ppb | In | 0.005 - 2000 ppm | Sn | 0.05 - 1000 ppm |
| Ba | 0.5 - 5000 ppm | La | 0.05 - 2000 ppm | Sr | 0.1 - 1000 ppm |
| Be | 0.02 - 1000 ppm | Li | 0.1 - 2000 ppm | Ta | 0.01 - 1000 ppm |
| Bi | 0.01 - 2000 ppm | Lu | 0.002 - 1000 ppm | Tb | 0.005 - 1000 ppm |
| Cd | 0.01 - 1000 ppm | Mn | 0.5 - 5000 ppm | Te | 0.02 - 1000 ppm |
| Ce | 0.05 - 2000 ppm | Mo | 0.02 - 2000 ppm | Th | 0.01 - 1000 ppm |
| Co | 0.1 - 1000 ppm | Nb | 0.02 - 2000 ppm | Tl | 0.01 - 1000 ppm |
| Cs | 0.01 - 2000 ppm | Nd | 0.025 - 2000 ppm | U | 0.01 - 1000 ppm |
| Cu | 0.5 - 5000 ppm | Ni | 0.5 - 5000 ppm | W | 1 - 1000 ppm |
| Dy | 0.01 - 2000 ppm | Pb | 0.2 - 1000 ppm | Y | 0.02 - 1000 ppm |
| Er | 0.01 - 2000 ppm | Pr | 0.01 - 1000 ppm | Yb | 0.01 - 1000 ppm |
| Eu | 0.01 - 2000 ppm | Rb | 0.05 - 1000 ppm | Zn | 1 - 5000 ppm |
| Ga | 0.05 - 1000 ppm | Re | 0.001 - 100 ppm | Zr | 0.1 - 2000 ppm |
| Gd | 0.01 - 2000 ppm | Sb | 0.02 - 1000 ppm | | |
| Hf | 0.01 - 2000 ppm | Sc | 0.1 - 1000 ppm | | |

Very low detection limits can be obtained by aqua regia digest and ICP-MS finish. This technique is applicable to exploration work as it yields rapid and accurate data.

Note: GE ARM133 and GE ARM155 are not available in all SGS laboratories. Please inquire.

MULTI-ACID (FOUR ACID) DIGESTION PACKAGES

NITRIC, HYDROFLUORIC, PERCHLORIC AND HYDROCHLORIC ACID DIGEST

Multi-acid (Four acid) digestion is a very effective dissolution procedure for a large number of mineral species and is suitable for a wide range of elements. Multi-acid digestion uses a combination of HNO₃ (nitric acid), HF (hydrofluoric acid), HClO₄ (perchloric acid) and HCl (hydrochloric acid). Because hydrofluoric acid dissolves silicate minerals, these digestions are often referred to as "near-total digestions". For more details, see our publication, Rocks to Results, Chapter 4.

NOTE: Requires a minimum sample weight of 0.5g. 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 can have slight differences in instrumentation. Please talk with your local lab manager to make sure you get the reporting limits you need.

NOTE: Refractory minerals such as oxides have limited solubility in multi-acid (Four acid) digestions. Often elements can precipitate or volatilize during digestion. These factors can compromise analytical results for Al, Ba, Cr, Hf, Mo, Mn, Nb, Pb, Si, Sn, Ti, Ta, W, Zr, As, Sb, Se and Te in some sample types.

MULTI-ACID (FOUR ACID) DIGESTION / ICP-AES PACKAGE (33 ELEMENTS)

GE ICP40B GE_ICP40Q12

ELEMENTS AND LIMIT(S)

| | | |
|------------------|--------------------|--------------------|
| Ag 2 - 100 ppm | Fe 0.01 - 15% | S 0.01 - 5% |
| Al 0.01 - 15% | K 0.01 - 15% | Sb 5 - 10000 ppm |
| As 3 - 10000 ppm | La 0.5 - 10000 ppm | Sc 0.5 - 10000 ppm |
| Ba 1 - 10000 ppm | Li 1 - 10000 ppm | Sn 10 - 10000 ppm |

| | | |
|--------------------|------------------|--------------------|
| Be 0.5 - 2500 ppm | Mg 0.01 - 15% | Sr 0.5 - 10000 ppm |
| Bi 5 - 10000 ppm | Mn 2 - 10000 ppm | Ti 0.01 - 15% |
| Ca 0.01 - 15% | Mo 1 - 10000 ppm | V 2 - 10000 ppm |
| Cd 1 - 10000 ppm | Na 0.01 - 15% | W 10 - 10000 ppm |
| Co 1 - 10000 ppm | Ni 1 - 10000 ppm | Y 0.5 - 10000 ppm |
| Cr 1 - 10000 ppm | P 0.01 - 15% | Zn 1 - 10000 ppm |
| Cu 0.5 - 10000 ppm | Pb 2 - 10000 ppm | Zr 0.5 - 10000 ppm |

Note: Additional elements can be added. Please inquire.

MULTI-ACID (FOUR ACID) DIGESTION / COMBINED ICP-AES AND ICP-MS PACKAGE (49 ELEMENTS)

GE ICM40B

ELEMENTS AND LIMIT(S)

| | | |
|---------------------|---------------------|---------------------|
| Ag 0.02 - 100 ppm | K 0.01 - 15% | Sn 0.3 - 1000 ppm |
| Al 0.01 - 15% | La 0.1 - 10000 ppm | Sr 0.5 - 10000 ppm |
| As 1 - 10000 ppm | Li 1 - 10000 ppm | Ta 0.05 - 10000 ppm |
| Ba 1 - 10000 ppm | Lu 0.01 - 1000 ppm | Tb 0.05 - 10000 ppm |
| Be 0.1 - 2500 ppm | Mg 0.01 - 15% | Te 0.05 - 1000 ppm |
| Bi 0.04 - 10000 ppm | Mn 2 - 10000 ppm | Th 0.2 - 10000 ppm |
| Ca 0.01 - 15% | Mo 0.05 - 10000 ppm | Ti 0.01 - 15% |
| Cd 0.02 - 10000 ppm | Na 0.01 - 15% | Tl 0.02 - 10000 ppm |
| Ce 0.05 - 1000 ppm | Nb 0.1 - 1000 ppm | U 0.05 - 10000 ppm |
| Cs 1 - 1000 ppm | Ni 0.5 - 10000 ppm | V 2 - 10000 ppm |
| Co 0.1 - 10000 ppm | P 0.01 - 15% | W 0.1 - 10000 ppm |
| Cr 1 - 10000 ppm | Pb 0.5 - 10000 ppm | Y 0.1 - 10000 ppm |
| Cu 0.5 - 10000 ppm | Rb 0.2 - 10000 ppm | Yb 0.1 - 1000 ppm |
| Fe 0.01 - 15% | S 0.01 - 5% | Zn 1 - 10000 ppm |
| Ga 0.1 - 500 ppm | Sb 0.05 - 10000 ppm | Zr 0.5 - 10000 ppm |
| Hf 0.02 - 500 ppm | Sc 0.1 - 1000 ppm | |
| In 0.02 - 500 ppm | Se 2 - 1000 ppm | |

Note: Select packages for rare earth elements can be found on pg 59.

FUSION PACKAGES

Fusion involves the complete digestion of the sample in molten flux. Fusions are generally more aggressive than acid digestion methods and are suitable for many refractory, difficult-to-dissolve minerals such as chromite, ilmenite, spinel, cassiterite and minerals of the tantalum-tungsten solid solution series. Fusion analyses are presumed to provide a complete chemical analysis and are referred to as a “total” analysis.

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

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 can have slight differences in instrumentation. Please talk with your local lab manager to make sure you get the reporting limits you need.

SODIUM PEROXIDE FUSION

Sodium peroxide is a strongly oxidizing flux that is basic, not acidic in nature. It renders most refractory minerals soluble. Because the fusion temperature is lower than that of lithium metaborate fusions, the hydride elements are not volatilized. This technique requires a minimum sample weight of 0.2 g.

SODIUM PEROXIDE FUSION / ICP-AES PACKAGE (29 ELEMENTS)

GE ICP90A GE_ICP90A50

ELEMENTS AND LIMIT(S)

| | | | | | |
|----|---------------|----|-------------|----|---------------|
| Al | 0.01 - 25% | K | 0.1 - 25% | Sc | 0.0005 - 5% |
| As | 0.003 - 10% | La | 0.001 - 5% | Si | 0.1 - 30% |
| Ba | 0.001 - 5% | Li | 0.001 - 5% | Sn | 0.005 - 5% |
| Be | 0.0005 - 2.5% | Mg | 0.01 - 25% | Sr | 0.001 - 0.5% |
| Ca | 0.1 - 25% | Mn | 0.001 - 10% | Ti | 0.01 - 25% |
| Cd | 0.001 - 5% | Mo | 0.001 - 5% | V | 0.001 - 5% |
| Co | 0.001 - 5% | Ni | 0.001 - 10% | W | 0.005 - 4% |
| Cr | 0.001 - 5% | P | 0.01 - 25% | Y | 0.0005 - 2.5% |
| Cu | 0.001 - 5% | Pb | 0.002 - 10% | Zn | 0.001 - 5% |
| Fe | 0.01 - 25% | Sb | 0.005 - 10% | | |

SODIUM PEROXIDE FUSION / COMBINED ICP-AES AND ICP-MS PACKAGE (56 ELEMENTS)

GE ICM90A

ELEMENTS AND LIMIT(S)

| | | | | | |
|----|-----------------|----|-----------------|----|-----------------|
| Ag | 1 - 200 ppm | Ge | 1 - 1000 ppm | Sb | 0.1 - 10000 ppm |
| Al | 0.01 - 25% | Hf | 1 - 10000 ppm | Si | 0.1 - 30% |
| As | 0.0005 - 10% | Ho | 0.05 - 1000 ppm | Sm | 0.1 - 1000 ppm |
| Ba | 10 - 10000 ppm | In | 0.2 - 1000 ppm | Sn | 1 - 10000 ppm |
| Be | 5 - 2500 ppm | K | 0.1 - 25% | Sr | 10 - 5000 ppm |
| Bi | 0.1 - 1000 ppm | La | 0.1 - 10000 ppm | Ta | 0.5 - 10000 ppm |
| Ca | 0.1 - 25% | Li | 0.001 - 5% | Tb | 0.05 - 1000 ppm |
| Cd | 0.2 - 10000 ppm | Lu | 0.05 - 1000 ppm | Th | 0.1 - 1000 ppm |
| Ce | 0.1 - 10000 ppm | Mg | 0.01 - 25% | Ti | 0.01 - 25% |
| Co | 0.5 - 10000 ppm | Mn | 0.001 - 10% | Tl | 0.5 - 1000 ppm |
| Cr | 0.001 - 5% | Mo | 2 - 10000 ppm | Tm | 0.05 - 1000 ppm |
| Cs | 0.1 - 10000 ppm | Nb | 1 - 10000 ppm | U | 0.05 - 1000 ppm |
| Cu | 10 - 10000 ppm | Nd | 0.1 - 10000 ppm | V | 5 - 10000 ppm |
| Dy | 0.05 - 1000 ppm | Ni | 5 - 10000 ppm | W | 1 - 10000 ppm |
| Er | 0.05 - 1000 ppm | P | 0.01 - 25% | Y | 0.5 - 1000 ppm |
| Eu | 0.05 - 1000 ppm | Pb | 5 - 10000 ppm | Yb | 0.1 - 1000 ppm |
| Fe | 0.01 - 25% | Pr | 0.05 - 1000 ppm | Zn | 5 - 10000 ppm |
| Ga | 1 - 1000 ppm | Rb | 0.2 - 10000 ppm | Zr | 0.5 - 10000 ppm |
| Gd | 0.05 - 1000 ppm | Sc | 0.0005 - 5% | | |

SGS now offers an innovative, low cost, multi-element, analytical fusion package (GE_IMS90A). This package offers the best recoveries, fastest analysis time with the widest range of limits and elements offered in a single pass.

SODIUM PEROXIDE FUSION / ICP-MS PACKAGE (34 ELEMENTS)

GE IMS90A GE_IMS90A50

ELEMENTS AND LIMIT(S)

| | | | | | |
|----|----------------|----|-----------------|----|----------------|
| Ag | 1 - 200 ppm | Fe | 0.01 - 25% | Si | 0.1 - 40% |
| Al | 0.01 - 25% | K | 0.1 - 30% | Sn | 1 - 10000 ppm |
| As | 3 - 10000 ppm | La | 0.1 - 10000 ppm | Sr | 10 - 10000 ppm |
| Ba | 10 - 10000 ppm | Li | 5 - 10000 ppm | Te | 1 - 1000 ppm |

| | | | | | |
|----|-----------------|----|----------------|----|-----------------|
| Be | 1 - 2500 ppm | Mg | 0.01 - 30% | Ti | 0.01 - 30% |
| Bi | 0.1 - 1000 ppm | Mn | 10 - 10000 ppm | V | 5 - 10000 ppm |
| Ca | 0.1 - 25% | Mo | 2 - 10000 ppm | W | 5 - 10000 ppm |
| Cd | 0.2 - 10000 ppm | Ni | 5 - 50000 ppm | Y | 0.5 - 10000 ppm |
| Co | 0.5 - 10000 ppm | P | 0.01 - 25% | Yb | 0.1 - 1000 ppm |
| Cr | 5 - 10000 ppm | Pb | 2 - 50000 ppm | Zn | 5 - 50000 ppm |
| Cs | 0.1 - 10000 ppm | S | 1 - 25% | | |
| Cu | 2 - 50000 ppm | Sb | 1 - 10000 ppm | | |

Note: This package is currently only available at our Burnaby, Canada location. An additional 22 elements (Ce, Dy, Er, Eu, Ga, Gd, Ge, Ho, In, Lu, Nb, Nd, Pr, Rb, Re, Sm, Ta, Tb, Th, Tl, Tm, U) can be added. Please inquire.

SODIUM PEROXIDE FUSION / HYDRIDE AAS PACKAGE

GE HAS90A GE_HAS90A20

ELEMENTS AND LIMIT(S)

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

LITHIUM METABORATE FUSION

Lithium metaborate fusion is a high temperature procedure that dissolves rock forming minerals, trace minerals and refractory minerals. Lithium metaborate fusion solutions can be analyzed by ICP-AES, ICP-MS or both ICP-AES and ICP-MS. This technique requires a minimum sample weight of 0.2 g.

LITHIUM METABORATE FUSION / ICP-MS PACKAGE (33 ELEMENTS)

GE IMS95A GE_IMS95A50

ELEMENTS AND LIMIT(S)

| | | | | | |
|----|-----------------|----|-----------------|----|------------------|
| Ag | 1 - 200 ppm | Ho | 0.05 - 1000 ppm | Ta | 0.5 - 10000 ppm |
| Ce | 0.1 - 10000 ppm | La | 0.1 - 10000 ppm | Tb | 0.05 - 1000 ppm |
| Co | 0.5 - 10000 ppm | Lu | 0.05 - 1000 ppm | Th | 0.1 - 1000 ppm |
| Cs | 0.1 - 10000 ppm | Mo | 2 - 10000 ppm | Tl | 0.5 - 1000 ppm |
| Cu | 5 - 10000 ppm | Nb | 1 - 10000 ppm | Tm | 0.05 - 1000 ppm |
| Dy | 0.05 - 1000 ppm | Nd | 0.1 - 10000 ppm | U | 0.05 - 10000 ppm |
| Er | 0.05 - 1000 ppm | Ni | 5 - 10000 ppm | V | 5 - 10000 ppm |
| Eu | 0.05 - 1000 ppm | Pr | 0.05 - 1000 ppm | W | 1 - 10000 ppm |

| | | | | | |
|----|-----------------|----|-----------------|----|----------------|
| Ga | 1 - 1000 ppm | Rb | 0.2 - 10000 ppm | Y | 0.5 - 1000ppm |
| Gd | 0.05 - 1000 ppm | Sm | 0.1 - 1000 ppm | Yb | 0.1 - 1000 ppm |
| Hf | 1 - 10000 ppm | Sn | 1 - 10000 ppm | Zr | 0.5 - 1000 ppm |

XRF ANALYSIS

X-ray fluorescence (XRF) spectroscopy has been available to the geochemical industry for over 50 years. It is the preferred method for the determination of the major oxides as well as some trace elements. The advantages of XRF include its:

- Accurate analyses, arising from the fact that inter-element corrections are well known and highly predictable.
- Precise determinations, due to inherent instrumental factors.
- Rapid analysis time.
- Ability to use a solid sample as opposed to a liquid digest.
- Wide analytical range which extends from the parts-per-million to tens of percent range.

Fusion and pressed pellet are the two industry-standard sample preparation techniques for XRF analysis. In pressed pellet XRF, samples are compressed into a pellet and analyzed instrumentally. Only lower levels of metals can be done accurately by this method. Fusion involves melting the sample with flux and casting it into a glass disc. Trace element and sulphide samples require specialized fusions or the pressed pellet technique. Please talk to us to determine the right method for your samples.

For information about fusion-XRF packages for whole rock samples, base metals, iron ores, REEs, and other minerals, please refer to the Ore-Grade Analysis section in this guide.

PRESSED PELLET / XRF PACKAGE (26 ELEMENTS)

GE XRF75V GE_XRF71

ELEMENTS AND LIMIT(S)

| | | | | | |
|----|---------------|----|----------------|----|---------------|
| As | 3 - 10000 ppm | Mn | 50 - 10000 ppm | Th | 5 - 10000 ppm |
| Ba | 10 - 4000 ppm | Mo | 3 - 10000 ppm | Ti | 4 - 10000 ppm |
| Ca | 0.01 - 20% | Nb | 2 - 4000 ppm | U | 5 - 4000 ppm |
| Co | 2 - 4000 ppm | Ni | 2 - 4000 ppm | V | 5 - 10000 ppm |

| | | | | | |
|----|---------------|----|---------------|----|--------------|
| Cr | 5 - 4000 ppm | Pb | 5 - 10000 ppm | W | 5 - 4000 ppm |
| Cu | 2 - 4000 ppm | Rb | 2 - 4000 ppm | Y | 2 - 4000 ppm |
| Ga | 3 - 4000 ppm | Sb | 3 - 4000 ppm | Zn | 2 - 4000 ppm |
| Ge | 5 - 10000 ppm | Sn | 3 - 4000 ppm | Zr | 3 - 4000 ppm |
| K | 0.01 - 20% | Sr | 2 - 4000 ppm | | |

Note: This method is not available at all SGS laboratories, please inquire. This technique requires a minimum sample weight of 12g.

MOBILE METAL ION – 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 exploration tool repeatedly proven to find buried mineral deposits.

MMI™ Technology is an innovative analytical process that uses a unique approach to the semi-quantitative 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 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 MMI solutions are the chemically active or ‘mobile’ component of the sample. Because these mobile, loosely bound complexes are in very low concentrations, elemental determinations are made 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.

- 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 protocol based on years of experience and research. In the absence of an orientation survey, samples must be taken at a constant depth (10-25 cm) 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 DRCII™, providing 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 us at minerals@sgs.com.

ICP-MS DRC II™

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 (1 ppb) is an important geological trace element. For uranium exploration, low level vanadium (1 ppb) is also important. If either or both of these elements are required for your program, we can analyze your samples for low chrome and/or vanadium values using our MMI-ME package.

Sulfur, bromine, iodine and lead isotopes can be added to the MMI packages. For these additional elements, please contact us at minerals@sgs.com.

MOBILE METAL ION STANDARD PACKAGE / ICP-MS (53 ELEMENTS)

GE MMI-M GE_MMIM

ELEMENTS AND LIMIT(S)

| | | | | | | | |
|----|---------|----|---------|----|---------|----|---------|
| Ag | 0.5 ppb | Er | 0.2 ppb | Nd | 1 ppb | Tb | 0.1 ppb |
| Al | 1 ppm | Eu | 0.2 ppb | Ni | 5 ppb | Te | 10 ppb |
| As | 10 ppb | Fe | 1 ppm | P | 0.1 ppm | Th | 0.5 ppb |
| Au | 0.1 ppb | Ga | 0.5 ppb | Pb | 5 ppb | Ti | 10 ppb |
| Ba | 10 ppb | Gd | 0.5 ppb | Pd | 1 ppb | Tl | 0.1 ppb |
| Bi | 0.5 ppb | Hg | 1 ppb | Pr | 0.5 ppb | U | 0.5 ppb |
| Ca | 2 ppm | In | 0.1 ppb | Pt | 0.1 ppb | W | 0.5 ppb |
| Cd | 1 ppb | K | 0.5 ppm | Rb | 1 ppb | Y | 1 ppb |

| | | | |
|------------|------------|------------|------------|
| Ce 2 ppb | La 1 ppb | Sb 0.5 ppb | Yb 0.2 ppb |
| Co 1 ppb | Li 1 ppb | Sc 5 ppb | Zn 10 ppb |
| Cr 100 ppb | Mg 0.5 ppm | Sm 1 ppb | Zr 2 ppb |
| Cs 0.2 ppb | Mn 100 ppb | Sn 1 ppb | |
| Cu 10 ppb | Mo 2 ppb | Sr 10 ppb | |
| Dy 0.5 ppb | Nb 0.5 ppb | Ta 1 ppb | |

MOBILE METAL ION ENHANCED PACKAGE / ICP-MS (55 ELEMENTS)

GE MMI-ME GE_MMIME

ELEMENTS AND LIMIT(S)

| | | | |
|------------|------------|------------|------------|
| Ag 0.5 ppb | Er 0.2 ppb | Nd 1 ppb | Ta 1 ppb |
| Al 1 ppm | Eu 0.2 ppb | Ni 5 ppb | Tb 0.1 ppb |
| As 10 ppb | Fe 1 ppm | P 0.1 ppm | Te 10 ppb |
| Au 0.1 ppb | Ga 0.5 ppb | Pb 5 ppb | Th 0.5 ppb |
| Ba 10 ppb | Gd 0.5 ppb | Pd 1 ppb | Ti 10 ppb |
| Bi 0.5 ppb | Hg 1 ppb | Pr 0.5 ppb | Tl 0.1 ppb |
| Ca 2 ppm | In 0.1 ppb | Pt 0.1 ppb | U 0.5 ppb |
| Cd 1 ppb | K 0.5 ppm | Rb 1 ppb | V 1 ppb |
| Ce 2 ppb | La 1 ppb | Sb 0.5 ppb | W 0.5 ppb |
| Co 1 ppb | Li 1 ppb | Sc 5 ppb | Y 1 ppb |
| Cr 1 ppb | Mg 0.5 ppm | Se 2 ppb | Yb 0.2 ppb |
| Cs 0.2 ppb | Mn 100 ppb | Sm 1 ppb | Zn 10 ppb |
| Cu 10 ppb | Mo 2 ppb | Sn 1 ppb | Zr 2 ppb |
| Dy 0.5 ppb | Nb 0.5 ppb | Sr 10 ppb | |

Note: Sulfur, bromine, iodine and lead isotopes can be added to the MMI-ME package by special request.

MOBILE METAL ION PRECIOUS METAL PLUS PACKAGE / ICP-MS (11 ELEMENTS)

GE MMI-MP GE_MMIMP

ELEMENTS AND LIMIT(S)

| | | | |
|-------------|------------|-----------|-----------|
| Au 0.05 ppb | Ag 0.1 ppb | Cu 10 ppb | Zn 10 ppb |
| Pd 0.1 ppb | Cd 0.5 ppb | Ni 5 ppb | U 0.5 ppb |
| Pt 0.02 ppb | Co 1 ppb | Pb 5 ppb | |

BIOGEOCHEMISTRY

SGS has considerable experience in the preparation and analysis of a wide range of vegetation samples. Such samples may be dried and macerated or ashed prior to acid digestion and analysis by ICP-MS. Please consult your local lab for more information on elements and limits.

GE ICM11D GE_ICP23D50 & GE_IMS23D50

HYDROGEOCHEMISTRY

The analyses offered in this section are suitable for groundwater samples used in mineral exploration, but NOT for salt water, brines, effluent solutions and 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 can increase. Requests for environmental services will be forwarded to an SGS Environmental Services Laboratory.

GROUND WATER ANALYSIS / ICP-AES PACKAGE (31 ELEMENTS)

GE ICP80T GE_ICP80T

ELEMENTS AND LIMIT(S)

| | | | |
|-----------|-----------|-----------|-----------|
| Ag 1 ppb | Co 10 ppb | Mo 10 ppb | Sr 1 ppb |
| Al 50 ppb | Cr 10 ppb | Na 50 ppb | Ti 10 ppb |
| As 30 ppb | Cu 5 ppb | Ni 10 ppb | V 10 ppb |
| Ba 10 ppb | Fe 50 ppb | P 50 ppb | W 50 ppb |
| Be 5 ppb | K 100 ppb | Pb 30 ppb | Y 5 ppb |
| Bi 50 ppb | La 10 ppb | Sb 50 ppb | Zn 5 ppb |
| Ca 50 ppb | Mg 50 ppb | Sc 1 ppb | Zr 10 ppb |
| Cd 10 ppb | Mn 5 ppb | Sn 50 ppb | |

GROUND WATER ANALYSIS / ICP-MS PACKAGE (49 ELEMENTS)

GE IMS80T GE_IMS80T

ELEMENTS AND LIMIT(S)

| | | | | | | | |
|----|----------|----|----------|----|----------|----|----------|
| Ag | 0.01 ppb | Eu | 0.01 ppb | Ni | 0.1 ppb | Th | 0.01 ppb |
| As | 1 ppb | Ga | 0.01 ppb | Pb | 0.01 ppb | Tl | 0.01 ppb |
| Ba | 0.01 ppb | Gd | 0.01 ppb | Pr | 0.01 ppb | Tm | 0.01 ppb |
| Be | 0.1 ppb | Hf | 0.01 ppb | Rb | 0.1 ppb | U | 0.01 ppb |
| Bi | 0.01 ppb | Hg | 0.2 ppb | Sb | 0.1 ppb | V | 1 ppb |
| Cd | 0.01 ppb | Ho | 0.01 ppb | Sc | 0.1 ppb | W | 0.01 ppb |
| Ce | 0.01 ppb | In | 0.01 ppb | Se | 1 ppb | Y | 0.01 ppb |
| Cs | 0.01 ppb | La | 0.01 ppb | Sm | 0.01 ppb | Yb | 0.01 ppb |
| Cr | 1 ppb | Lu | 0.05 ppb | Sn | 0.01 ppb | Zn | 1 ppb |
| Co | 0.1 ppb | Mn | 0.1 ppb | Sr | 0.01 ppb | Zr | 0.1 ppb |
| Cu | 0.1 ppb | Mo | 1 ppb | Ta | 0.01 ppb | | |
| Dy | 0.1 ppb | Nb | 0.01 ppb | Tb | 0.01 ppb | | |
| Er | 0.01 ppb | Nd | 0.01 ppb | Te | 0.1 ppb | | |

Note: Au, Pt, Pd, Rh, Ru, Ir and Re can be added upon request.

ADDITIONAL GROUND WATER ANALYSIS

| CODE(S) | ELEMENT | DESCRIPTION |
|------------------------|------------------------------|-------------------------------|
| GE PHY22V G_PHY14V | Total dissolved solids (TDS) | Gravimetric |
| GE ISE06T GC_ISE10T | pH | Ion selective electrode (ISE) |
| GE ISE07T GE_ISE21T | Fluoride F ⁻ | Ion selective electrode (ISE) |
| GE ISE08T GE_ISE30T | Chloride Cl ⁻ | Ion selective electrode (ISE) |

INDIVIDUAL METHODS FOR EXPLORATION-GRADE ANALYSIS

SULPHUR AND CARBON

| CODE(S) | ELEMENT | LIMIT(S) | DESCRIPTION | MIN. SAMPLE WT.(g) |
|------------------------|-------------------------------|-------------|--------------------------------|--------------------|
| GE CSA06V GE_CSA06V | S | 0.005 - 30% | IR Combustion | 0.2 |
| | C | 0.005 - 30% | | 0.2 |
| GE CSA07V GC_CSA07V | SO ₄ ²⁻ | 0.01% | Leach/ IR combustion | 1.0 |
| GE CSA08V GE_CSA08Q | S ²⁻ | 0.01% | Leach/Digest/ IR combustion | 2.0 |
| GE CSA09V | S (elemental) | 0.01% | Leach/Gravimetry | 1.0 |
| GE CSA02V GE_CSA02Q | CO ₂ (Carbonate) | 0.05% | IR combustion | 1.0 |
| GE CSB02V GE_CSB02V | CO ₂ (Carbonate) | 0.05% | Coulometry | 1.0 |
| GE CSA03V GE_CSA03B | C (organic, inorganic) | 0.01% | IR combustion | 1.0 |
| GE CSB03V GE_CSB03V | C (organic, inorganic) | 0.05% | Coulometry | 1.0 |
| GE CSA05V GE_CSA05V | C (graphitic) | 0.05% | IR combustion | 1.0 |
| GE CSB05V GE_CSB05A | C (graphitic) | 0.05% | Coulometry | 1.0 |

ADDITIONAL SINGLE ELEMENTS

| CODE(S) | ELEMENT | LIMIT(S) | DESCRIPTION | MIN. SAMPLE WT.(g) |
|--------------------------|---------|-----------------|----------------------------|--------------------|
| GE CVA20A GE_CVA37A25 | Hg | 0.005 - 100 ppm | Cold vapour AAS | 0.2 |
| GE ISE07A GE_ISE20V | F | 0.0025 - 10% | Ion selective electrode | 0.2 |
| GE ISE08B GE_ISE30V | Cl | 50 - 5000 ppm | Ion selective electrode | 0.5 |
| GE CLA02V GO_CLA31V | Cl | 20 -5000 ppm | Titration | 0.5 |

GE ISE15V pH (soils/sediments) Ion selective electrode (ISE)
 GC_ISE10V

SGS offers a wide variety of specific element analyses. Please contact your local site.

ORE-GRADE ANALYSIS

Ore-grade packages are used to analyse samples that have high concentrations of pay metals. They can be used in prefeasibility, feasibility or production circumstances. As well, these methods can be used to provide over range analysis when an upper limit of an element in an exploration package is exceeded. Typically, ore-grade analyses are accomplished by adjusting the sample weight and final solution volume ratio, thus expanding the linear range of the analysis. Refer to GO ICP13B and GO ICP41Q below. Additional elements are available, please inquire.

OVER RANGE PACKAGES

AQUA REGIA DIGESTION / ICP-AES PACKAGE (12 ELEMENTS)

GO ICP13B GO_ICP21B100

ELEMENTS AND LIMIT(S)

| | | |
|----------------|----------------|----------------|
| Ag 0.01 - 0.1% | Cu 0.01 - 30% | Ni 0.001 - 10% |
| As 0.01 - 10% | Fe 0.01 - 30% | Pb 0.001 - 10% |
| Cd 0.001 - 10% | Mn 0.01 - 10% | S 0.01 - 30% |
| Co 0.001 - 10% | Mo 0.001 - 10% | Zn 0.01 - 10% |

MULTI-ACID (FOUR ACID) DIGESTION / ICP-AES PACKAGE (33 ELEMENTS)

GO ICP41Q GO_ICP42Q100

ELEMENTS AND LIMIT(S)

| | | |
|----------------|----------------|----------------|
| Ag 0.01 - 0.1% | Fe 0.01 - 30% | Ni 0.001 - 10% |
| As 0.01 - 10% | Li 0.01 - 10% | Pb 0.01 - 30% |
| Cd 0.001 - 10% | Mn 0.001 - 10% | S 0.01 - 10% |

| | | |
|----------------|----------------|---------------|
| Co 0.001 - 10% | Mo 0.001 - 10% | Zn 0.01 - 30% |
| Cu 0.01 - 30% | | |

Note: Additional elements can be added to either package upon request. For a total digest over range package, refer to our fusion package, GO ICP90Q on page 50.

MULTI-ACID (FOUR ACID) DIGESTION PACKAGES

FOUR ACID DIGESTION / AAS PACKAGE (16 ELEMENTS)

GO AAS42S GO_AAS41S100

ELEMENTS AND LIMIT(S)

| | | |
|------------------|----------------|-----------------|
| Ag 5 - 500 ppm | Cr 0.005 - 5% | Pb 0.002 - 2.5% |
| As 0.025 - 5% | Cu 0.001 - 50% | Sb 0.01 - 2% |
| Bi 50 - 5000 ppm | Fe 0.01 - 40% | V 0.005 - 5% |
| Ca 0.01 - 40% | Mn 0.001 - 5% | Zn 0.001 - 5% |
| Cd 5 - 5000 ppm | Mo 0.002 - 5% | |
| Co 0.002 - 2.5% | Ni 0.001 - 5% | |

FOUR ACID DIGESTION / ICP-AES PACKAGE (26 ELEMENTS)

GO ICP42S GO_ICP41S100

ELEMENTS AND LIMIT(S)

| | | |
|-----------------|-----------------|------------------|
| Ag 5 - 250 ppm | Fe 0.025 - 100% | Pb 0.0025 - 2.5% |
| Al 0.025 - 40% | K 0.1 - 40% | Sb 0.001 - 2% |
| As 0.002 - 2.5% | Li 5 - 2500 ppm | Sn 0.002 - 2% |
| Bi 0.005 - 2.5% | Mg 0.005 - 40% | Ta 0.005 - 2.5% |
| Ca 0.01 - 40% | Mn 0.002 - 2.5% | Ti 0.002 - 5% |
| Cd 0.0005 - 2% | Mo 0.002 - 2.5% | V 0.0005 - 2.5% |
| Co 0.001 - 2.5% | Na 0.01 - 40% | Zn 0.001 - 5% |
| Cr 0.002 - 5% | Ni 0.002 - 2.5% | Zr 0.001 - 5% |
| Cu 0.001 - 2.5% | P 0.01 - 25% | |

Note: Requires a minimum sample weight of 0.5 g.

FUSION-ICP PACKAGES

SODIUM PEROXIDE FUSION / ICP-AES PACKAGE

GO ICP90Q GO_ICP90Q100

ELEMENTS AND LIMIT(S)

| | | | | | |
|----|------------|----|------------|----|------------|
| Co | 0.01 - 30% | Mo | 0.01 - 30% | Pb | 0.01 - 30% |
| Cu | 0.01 - 30% | Ni | 0.01 - 30% | Zn | 0.01 - 30% |
| Fe | 0.05 - 50% | | | | |

Additional elements can be added to this method upon request (e.g., As, Bi, Cd, Mg, Mn) Elements greater than 30% can require analysis by another technique for full recovery. Requires a minimum sample weight of 0.5 g.

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

GO ICP95A GO_ICP95A50

ELEMENTS AND LIMIT(S)

| | | | | | |
|--------------------------------|-------------|-------------------------------|-------------|------------------|---------------|
| Al ₂ O ₃ | 0.01 - 75% | MgO | 0.01 - 30% | Sr | 0.001 - 10% |
| Ba | 0.001 - 10% | MnO | 0.01 - 10% | TiO ₂ | 0.01 - 25% |
| CaO | 0.01 - 60% | Na ₂ O | 0.01 - 30% | Y | 0.001 - 10% |
| Cr ₂ O ₃ | 0.01 - 10% | Nb | 0.001 - 10% | Zn | 5 - 10000 ppm |
| Fe ₂ O ₃ | 0.01 - 75% | P ₂ O ₅ | 0.01 - 25% | Zr | 0.001 - 10% |
| K ₂ O | 0.01 - 25% | SiO ₂ | 0.01 - 90% | LOI | -10 - 100% |

Requires a minimum sample weight of 0.5g.

FUSION-XRF PACKAGES

Whole rock analysis is the determination of major elements (reported as "oxides"). This analysis will approximate 100% in non-mineralized samples. SGS offers whole rock analysis using both ICP-AES or XRF below.

Whole rock analysis by XRF is particularly suitable for the analysis of bulk commodities such as iron ore, silicate, feldspar, gypsum and limestone. This method is not suitable for samples with a sulphide mineral content > 1%.

BORATE FUSION / XRF WHOLE ROCK PACKAGE (13 ELEMENTS)

GO XRF76V GO_XRF72

ELEMENTS AND LIMIT(S)

| | | | | | |
|--------------------------------|-------------|--------------------------------|-------------|-------------------------------|-------------|
| Al ₂ O ₃ | 0.01 - 100% | MnO | 0.01 - 100% | TiO ₂ | 0.01 - 100% |
| CaO | 0.01 - 100% | Na ₂ O | 0.01 - 100% | V ₂ O ₅ | 0.01 - 100% |
| Cr ₂ O ₃ | 0.01 - 100% | P ₂ O ₅ | 0.01 - 100% | LOI | -10 - 100% |
| K ₂ O | 0.01 - 100% | Fe ₂ O ₃ | 0.01 - 100% | SUM | % |
| MgO | 0.01 - 100% | SiO ₂ | 0.01 - 100% | | |

Additional major and minor elements can be added to the borate fusion / XRF method. Requires a minimum sample weight of 5.0 g. Please contact your local lab. Rare earth elements can also be analyzed by this technique. Refer to page 64. For iron ore samples (GO XRF78S), refer to page 68.

PYROSULPHATE FUSION / XRF BASE METAL PACKAGE (10 ELEMENTS)

GO XRF77B GO_XRF70V

ELEMENTS AND LIMIT(S)

| | | | | | |
|----|-------------|----|-------------|----|-------------|
| Co | 0.01 - 100% | Mn | 0.01 - 100% | W | 0.01 - 100% |
| Cr | 0.01 - 100% | Mo | 0.01 - 100% | Zn | 0.01 - 100% |
| Cu | 0.01 - 100% | Ni | 0.01 - 100% | | |
| Fe | 0.01 - 100% | Pb | 0.01 - 100% | | |

Note: Requires a minimum sample weight of 1.0 g.

INDIVIDUAL METHODS FOR ORE-GRADE ANALYSIS

INTERNAL STANDARD / RESISTIVE MINERALS / XRF

GO XRF75F GO_XRF71

ELEMENTS AND LIMIT(S)

| | | | | | | | |
|----|---------|----|---------|-------------------------------|---------|-----------------|---------|
| As | ≥0.001% | Sn | ≥0.002% | ThO ₂ | ≥0.005% | WO ₃ | ≥0.002% |
| Sb | ≥0.002% | Ta | ≥0.002% | U ₃ O ₈ | ≥0.002% | | |

Note: Requires a minimum sample weight of 25 g. depending on the elements of interest. This method is not available at all SGS laboratories. Please inquire.

SULPHUR AND CARBON

| CODE | ELEMENT | LIMIT(S) | DESCRIPTION |
|------------------------|---------|------------|---------------|
| GO CSA06V GO_CSA06V | S | 0.01 - 75% | IR combustion |
| | C | 0.01 - 75% | |

Note: Requires a minimum sample weight of 0.2 g. Carbon and sulphur can be speciated using a variety of methods. Please inquire.

ADDITIONAL SINGLE ELEMENTS

| CODE(S) | ELEMENT | LIMIT(S) | DESCRIPTION | MIN. SAMPLE WT.(g) |
|--------------------------|----------------------|---------------|----------------------------------|--------------------|
| GO CVA20B GO_CVA38B50 | Hg | 0.3ppm - 100% | Cold vapour AAS | 0.4 |
| GO CLA10E GC_CLA04V | Insolubles (acid) | 0.1% | Gravimetric | 5 |
| GO CLA07C GC_CLA03V | CaO | 0.01% | Available lime | 2 |
| GO CLA01V GO_CLA01V | FeO | 0.1 - 30% | Ferric/Ferrous iron titration | 0.5 |

SGS can analyse a number of individual ore-grade elements. Please inquire.

CONTROL-GRADE ANALYSIS

Metallurgical processes are monitored and controlled by the chemical analysis of feed and head samples, 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 such samples. Several of the techniques are listed here, but this list is not meant to be 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 both multi-element packages and customized spectroscopic determinations that can include multiple dilutions and spectral analyses on an element-by-element basis to ensure that the interferences common in complex samples are identified and resolved.

These control assay methods are only a small selection 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, sulphur 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.

TWO ACID/AQUA REGIA DIGESTION PACKAGES

AQUA REGIA DIGESTION PACKAGE / ICP-AES (30 ELEMENTS)**GC ICP14C GC_ICP21C50****ELEMENTS AND REPORTING LIMIT(S)**

| | | | |
|-------------|------------|-----------|-------------|
| Ag 0.8 ppm | Co 3 ppm | Mo 6 ppm | Sr 0.02 ppm |
| Al 2 ppm | Cr 1 ppm | Na 20 ppm | Ti 0.2 ppm |
| As 30 ppm | Cu 1 ppm | Ni 6 ppm | Tl 30 ppm |
| Ba 0.07 ppm | Fe 2 ppm | P 50 ppm | V 2 ppm |
| Be 0.02 ppm | K 10 ppm | Pb 20 ppm | Y 0.2 ppm |
| Bi 10 ppm | Li 20 ppm | Sb 10 ppm | Zn 7 ppm |
| Ca 9 ppm | Mg 0.7 ppm | Se 30 ppm | |
| Cd 0.9 ppm | Mn 0.4 ppm | Sn 20 ppm | |

Additional elements can be added. An ICP-MS option is available. Concentrate samples containing greater than 50% of the target element can require alternative analytical methods if full recovery is required. Requires a minimum sample weight of 1.0 g.

MULTI-ACID (FOUR ACID) DIGESTION PACKAGES

MULTI-ACID DIGESTION PACKAGE / ICP-AES (30 ELEMENTS)

GC ICP42C GC_ICP42C100

ELEMENTS AND REPORTING LIMIT(S)

| | | | |
|-------------|------------|------------|-------------|
| Ag 2 ppm | Co 4 ppm | Mo 5 ppm | Sr 0.03 ppm |
| Al* 2 ppm | Cr* 4 ppm | Na 10 ppm | Ti* 0.4 ppm |
| As* 30 ppm | Cu 0.5 ppm | Ni 20 ppm | Tl 30 ppm |
| Ba* 0.2 ppm | Fe 4 ppm | P 30 ppm | V 2 ppm |
| Be 0.03 ppm | K* 20 ppm | Pb 20 ppm | Y 0.2 ppm |
| Bi 20 ppm | Li 5 ppm | Sb* 10 ppm | Zn 2 ppm |
| Ca* 20 ppm | Mg* 1 ppm | Se 30 ppm | |
| Cd 2 ppm | Mn 0.3 ppm | Sn* 20 ppm | |

Additional elements can be added. An ICP-MS option is available. Requires a minimum sample weight of 1.0 g. Concentrate samples containing greater than 50% of the target element can require alternative analytical methods if full recovery is required.

*Recovery can be incomplete so analysis can be biased low.

MULTI-ACID DIGESTION PACKAGE / FUSION / ICP-AES (30 ELEMENTS)

GC ICP46C GC_ICP46C100

ELEMENTS AND REPORTING LIMIT(S)

| | | | |
|-------------|------------|-----------|-------------|
| Ag 2 ppm | Co 4 ppm | Mo 5 ppm | Sr 0.03 ppm |
| Al 2 ppm | Cr 4 ppm | Na 10 ppm | Ti 0.4 ppm |
| As 30 ppm | Cu 0.5 ppm | Ni 20 ppm | Tl 30 ppm |
| Ba 0.2 ppm | Fe 4 ppm | P 30 ppm | V 2 ppm |
| Be 0.03 ppm | K 20 ppm | Pb 20 ppm | Y 0.2 ppm |
| Bi 20 ppm | Li 5 ppm | Sb 10 ppm | Zn 2 ppm |
| Ca 20 ppm | Mg 1 ppm | Se 30 ppm | |
| Cd 2 ppm | Mn 0.3 ppm | Sn 20 ppm | |

Additional elements can be added. An ICP-MS option is available. Requires a minimum sample weight of 1.0 g. Concentrate samples containing greater than 50% of the target element can require alternative analytical methods if full recovery is re-quired. Data for volatiles (e.g., As, Sb) may be incomplete.

FUSION PACKAGES

FUSION / ICP-AES PACKAGE (28 ELEMENTS)

GC ICP93A GC_ICP93A50

ELEMENTS AND REPORTING LIMIT(S)

| | | | |
|-------------|------------|-------------|-------------|
| Ag 200 ppm | Co 200 ppm | Mo 300 ppm | Tl 2000 ppm |
| Al 400 ppm | Cr 40 ppm | Ni 300 ppm | V 80 ppm |
| As 1200 ppm | Cu 40 ppm | Pb 800 ppm | Y 8 ppm |
| Ba 3 ppm | Fe 500 ppm | Sb 400 ppm | Zn 300 ppm |
| Be 0.8 ppm | K 400 ppm | Se 2000 ppm | |
| Bi 400 ppm | Li 800 ppm | Sn 800 ppm | |
| Ca 800 ppm | Mg 30 ppm | Sr 10 ppm | |
| Cd 40 ppm | Mn 20 ppm | Ti 8 ppm | |

Additional elements can be added. An ICP-MS option is available. Requires a minimum sample weight of 0.2 g. Concentrate samples containing greater than 50% of the target element can require alternative analytical methods if full recovery is required.

FUSION / AAS PACKAGE (11 ELEMENTS)

GC AAS93A GC_ASS93A50

ELEMENTS AND REPORTING LIMIT(S)

| | | | |
|------------|------------|-----------|------------|
| Al 0.02 % | Fe 0.01 % | Si 0.07 % | V 0.1 % |
| Ca 0.06 % | Mg 0.005 % | Sn 0.05 % | Zn 0.001 % |
| Cr 0.005 % | Mn 0.005 % | Ti 0.05 % | |

Additional elements can be added. An ICP-MS option is available. Requires a minimum sample weight of 0.2 g. Concentrate samples containing greater than 50% of the target element can require alternative analytical methods if full recovery is required.

FUSION / XRF CONTROL-GRADE PACKAGES

| CODE(S) | ELEMENTS / LIMIT(S) | DESCRIPTION |
|------------------------|---|---------------------------|
| GC XRF76V GC_XRF72 | Refer to Ore-Grade Analysis section for elements and ranges | Borate fusion / XRF |
| GC XRF77B GC_XRF70V | Refer to Ore-Grade Analysis section for elements and ranges | Pyrosulphate fusion / XRF |
| GC XRF75F GE_XRF71 | Refer to Ore-Grade Analysis section for elements and ranges | Internal standard / XRF |

PROCESS SOLUTION PACKAGES

PROCESS SOLUTION PACKAGE / ICP-AES / NON-CYANIDE BASED (30 ELEMENTS)

GC SOL91T GC_ICP84T

ELEMENTS AND REPORTING LIMIT(S)

| | | | |
|--------------|-------------|------------|--------------|
| Ag 0.08 ppm | Co 0.3 ppm | Mo 0.6 ppm | Sr 0.002 ppm |
| Al 0.2 ppm | Cr 0.1 ppm | Na 2 ppm | Ti 0.02 ppm |
| As 3 ppm | Cu 0.1 ppm | Ni 0.6 ppm | Tl 3 ppm |
| Ba 0.007 ppm | Fe 0.2 ppm | P 5 ppm | V 0.2 ppm |
| Be 0.002 ppm | K 1 ppm | Pb 2 ppm | Y 0.02 ppm |
| Bi 1 ppm | Li 2 ppm | Sb 1 ppm | Zn 0.7 ppm |
| Ca 0.9 ppm | Mg 0.07 ppm | Se 3 ppm | |
| Cd 0.09 ppm | Mn 0.04 ppm | Sn 2 ppm | |

Additional elements can be added. Requires a minimum sample volume of 5 mL. ICP-MS option may be available locally. Please inquire.

PROCESS SOLUTION PACKAGE / ICP-AES / CYANIDE BASED (30 ELEMENTS)

GC SOL92T GC_ICP82T

ELEMENTS AND REPORTING LIMIT(S)

| | | | |
|--------------|------------|------------|--------------|
| Ag 0.08 ppm | Co 0.3 ppm | Mo 0.6 ppm | Sr 0.002 ppm |
| Al 0.2 ppm | Cr 0.1 ppm | Na 2 ppm | Ti 0.02 ppm |
| As 3 ppm | Cu 0.1 ppm | Ni 0.6 ppm | Tl 3 ppm |
| Ba 0.007 ppm | Fe 0.2 ppm | P 5 ppm | V 0.2 ppm |
| Be 0.002 ppm | K 1 ppm | Pb 2 ppm | Y 0.02 ppm |

| | | | |
|-------------|-------------|----------|------------|
| Bi 1 ppm | Li 2 ppm | Sb 1 ppm | Zn 0.7 ppm |
| Ca 0.9 ppm | Mg 0.07 ppm | Se 3 ppm | |
| Cd 0.09 ppm | Mn 0.04 ppm | Sn 2 ppm | |

Additional elements can be added. Requires a minimum sample volume of 10 mL. ICP-MS option may be available locally. Please inquire.

INDIVIDUAL METHODS FOR CONTROL-GRADE ANALYSIS

SULPHUR AND CARBON

| CODE(S) | ELEMENT | LIMIT(S) | DESCRIPTION | MIN. SAMPLE WT.(g) |
|------------------------|-----------------|-------------|------------------|--------------------|
| GC CSA06V GC_CSA06V | S | 0.01 - 100% | IR combustion | 0.2 |
| | C | 0.01 - 100% | | 0.2 |
| GC CSA08V GC_CSA08E | S ²⁻ | 0.01 - 100% | Leach/Digest/IR | 2.0 |
| GC CSA09V | S (elemental) | 0.1 - 30% | Leach/Gravimetry | 1.0 |

Single elements can be determined by numerous decomposition techniques and finishes. Please contact your local lab for options.

VOLUMETRIC AND GRAVIMETRIC METHODS FOR CONCENTRATES

| CODE(S) | ELEMENT | LIMIT(S) | DESCRIPTION | MIN. SAMPLE WT.(g) |
|------------------------|---------|-----------|----------------|--------------------|
| GC CON13V GC_CON13V | Cu | 5 - 60% | Titration | 2.0 |
| GC CON03V GC_CON03V | Cu | 5 - 100% | Electroplating | 5.0 |
| GC CON07V GC_CON07V | Ni | 10 - 100% | Electroplating | 5.0 |
| GC CON11V GC_CON11V | Pb | 10 - 70% | Titration | 2.0 |
| GC CON12V GC_CON12V | Zn | 5 - 65% | Titration | 2.0 |
| GC CON08V GC_CON08V | Fe | 10 - 75% | Titration | 0.5 |

Note: these elements can be analyzed to party or umpire quality standards (GT) and can be reported up to 100%. Refer to the Commercial Trade Analysis section in this guide. Additional elements can be determined on concentrate samples in some SGS laboratories. Please inquire. Trade sample analyses typically require moisture analysis and may require a larger minimum sample weight.

COMMERCIAL TRADE ANALYSIS

SGS is the global leader and innovator in inspection, verification, testing and certification services. Our Minerals Services group, with its global network of laboratories and offices, provides customers with weighing, inspection, sampling and analytical services that are highly respected throughout the industry.

When possible, we follow published, accredited procedures and test methods. As well, SGS can accept your specialty methods and jointly ensure that your analytical results meet your needs and are suitably in control. The SGS Centre of Excellence laboratories that perform these commercial assays conform to the requirements of the ISO/IEC 17025:2005 standard for specific registered tests. SGS recognizes that your reputation and financial position can be at stake during commercial transactions and so we strive to continually improve our services and processes.

SGS' commercial analysis offerings consist of:

- 'Load-port' or 'pre-shipment' assays used by underwriters to quickly confirm product quality and determine approximate 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 the quality required and turn-around requirements that are demanded during some loading operations.
- Party analyses (also known as settlement or assay exchange analysis) are used to determine the quality of a commodity or product and thus its value and the payment due. The major or payable elements and all minor or penalty parameters are measured and reported. Party assays use commodity-specific methodology and require rigorous quality control steps. SGS employs rugged and reliable procedures, including traditional fire assay, classical gravimetric analysis, electroplating and volumetric titrimetry as well as AAS, ICP-AES and ICP-MS in this type of work.

- Umpire assays are used to resolve a dispute between a buyer and a seller. Samples of the cargo or product are analyzed in triplicate (at minimum) using approved, accredited methods and quality control protocols are set to provide the highest level of accuracy and precision.
- Product verification analysis for validation. SGS has the experience, ability and international approvals to test all types of products against published specifications, such as minimum or maximum limits, weights, quantities or other physical parameters.

SGS Minerals Services works for you to protect your interests and reduce your risk. Please contact us for the services and pricing specific to your commodity, cargo, product shipment and testing needs.

SELECT METHODS

SGS offers a wide variety of select methods to analyze specific elements, species and/or groups of elements. These methods address specific circumstances that arise due to mineralogy, chemistry or commercial requirements. A selection of commonly requested methods are listed below and others are available. Please inquire.

RARE EARTH ELEMENT ANALYSIS

Rare earth element (REE) samples can be analyzed using a variety of techniques depending on the concentration levels in the samples. The following packages are available for trace to percent level concentrations. Please inquire to ensure we meet your requirements.

The following exploration packages contain REEs or can have additional REE elements requested.

RARE EARTH ELEMENT ADD ON TRACE PACKAGES

| CODE(S) | ADDITIONAL ELEMENTS* | DESCRIPTION |
|---|---------------------------------------|--|
| GE IMS12B / GE IMS14B GE_IMS22B20 / GE_IMS21B20 | Pr, Nd, Sm, Eu, Gd, Dy, Ho, Er, Tm | 2-Acid / AR digest / ICP-MS |
| GE ICM12B / GE ICM14B | Pr, Nd, Sm, Eu, Gd, Dy, Ho, Er, Tm | 2-Acid / AR digest / ICP-AES / ICP-MS |
| GE ICM40B | Pr, Nd, Sm, Eu, Gd, Dy, Ho, Er, Tm | 4-Acid digest / ICP-AES / ICP-MS |

* REE elements that can be added to existing package

RARE EARTH ELEMENT INCLUSIVE TRACE PACKAGES

| CODE(S) | ELEMENTS | DESCRIPTION |
|--------------------------|----------------|--|
| GE ICM90A | Refer to pg.39 | Sodium peroxide fusion / ICP-AES / ICP-MS |
| GE IMS95A GE_IMS95A50 | Refer to pg.41 | Lithium metaborate fusion / ICP-MS |

SODIUM PEROXIDE FUSION / ICP-MS REE ORE GRADE PACKAGE (17 ELEMENTS)

GO IMS91B GO_IMS91Q100

ELEMENTS AND LIMIT(S)

| | | | |
|-----------|------------|------------|---------|
| La 50 ppm | Eu 1 ppm | Er 0.5 ppm | Y 5 ppm |
| Ce 50 ppm | Gd 5 ppm | Tm 0.1 ppm | U 1 ppm |
| Pr 10 ppm | Tb 1 ppm | Yb 1 ppm | |
| Nd 50 ppm | Dy 1 ppm | Lu 0.2 ppm | |
| Sm 10 ppm | Ho 0.1 ppm | Th 5 ppm | |

Note: Other elements are available, please inquire. This technique requires a minimum sample weight of 0.5 g.

BORATE FUSION / XRF REE ORE GRADE PACKAGE

GO XRF76R GO_XRF72

ELEMENTS AND LIMIT(S)

| | | |
|--|--|---|
| La ₂ O ₃ 0.01 - 100% | Nd ₂ O ₃ 0.02 - 100% | Y ₂ O ₃ 0.02 - 100% |
| Ce ₂ O ₃ 0.02 - 100% | Sm ₂ O ₃ 0.05 - 100% | U ₃ O ₈ 0.01 - 100% |
| Pr ₂ O ₃ 0.03 - 100% | ThO ₂ 0.01 - 100% | |

Note: Other elements are available, please inquire. This technique requires a minimum sample weight of 5.0 g.

SELECT COPPER METHODS

Copper can occur as oxide, sulphide and metallic forms in mineral deposits and metallurgical products so there are a variety of different analytical techniques available.

Note: Refer to the Exploration-Grade Analysis section for descriptions of the 12B, 14B, 40B and 90A digestion techniques. For descriptions of the 13B, 41Q, 42S and 90Q techniques, please see the Ore-Grade Analysis section, and for 13V and 03V refer to the Control-Grade Analysis section.

EXPLORATION-GRADE COPPER METHODS

| CODE(S) | LIMIT(S) | DESCRIPTION |
|--|--------------|--|
| GE ICP12B / GE ICP14B GE_ICP22B20 / GE_ICP21B20 | 0.5 ppm - 1% | 2-Acid digest / Aqua regia – ICP-AES |
| GE IMS12B / GE IMS14B GE_IMS22B20 / GE_IMS21B20 | 0.5 ppm - 1% | 2-Acid digest / Aqua regia – ICP-MS |
| GE ICM12B / GE ICM14B | 0.5 ppm - 1% | 2-Acid digest / Aqua regia – ICP-AES / ICP-MS |
| GE ICP40B GE_ICP40Q12 | 0.5 ppm - 1% | 4-Acid digest – ICP-AES |
| GE ICM40B | 0.5 ppm - 1% | 4-Acid digest – ICP-AES / ICP-MS |
| GE ICP90A GE_ICP90A50 | 10 ppm - 5% | Fusion – ICP-AES |
| GE ICM90A | 10 ppm - 1% | Fusion – ICP-AES / ICP-MS |
| GE IMS90A GE_IMS90A50 | 2 ppm - 5% | Fusion – ICP-MS |

ORE-GRADE COPPER METHODS

| CODE(S) | LIMIT(S) | DESCRIPTION |
|---------------------------|-------------|-----------------------------|
| GO ICP13B GO_ICP21B100 | 0.01 - 30% | Aqua regia digest – ICP-AES |
| GO ICP41Q GO_ICP42Q100 | 0.01 - 30% | 4-Acid digest – ICP-AES |
| GO AAS42S GO_AAS41S100 | 0.001 - 50% | 4-Acid digest – AAS |
| GO ICP90Q GO_ICP90Q100 | 0.01 - 30% | Fusion – ICP-AES |

CONCENTRATE-GRADE COPPER METHODS

| CODE(S) | LIMIT(S) | DESCRIPTION |
|-------------------------|------------|------------------------|
| GC CON13V* GC_CON13V | 5 - 60% * | Short iodide titration |
| GC CON03V* GC_CON03V | 5 - 100% * | Electrogravimetry |

* These methods can be done at party or umpire quality (GT). In these cases, the upper end of the reporting range will be 100%.

MINERAL SELECTIVE COPPER METHODS

| CODE(S) | LIMIT(S) | DESCRIPTION |
|---|----------|--|
| GO AAS71D GC_AAS70D200 | >0.002 % | Cu oxide method, citric acid leach, AAS |
| GO AAS72B GC_AAS71C50 | >0.002 % | Cu (non-sulphide method), H ₂ SO ₄ leach, AAS |
| GO AAS77C GC_AAS74C50 | >0.002 % | Cu acetic acid soluble, AAS finish |
| GO CSC67D GC_AAS75C100 | >0.002 % | CN soluble Cu, AAS finish |
| GO AAS01D GC_AAS01D250 | >0.001 % | Metallic Cu, AgNO ₃ digest, AAS |
| GO SQL01/02/03D GC_ASQ01D100V GC_ASQ02D100V GC_ASQ03D50V | >0.002 % | Sequential Cu leach (H ₂ SO ₄ soluble Cu, Cyanide soluble Cu, residual Cu), AAS finish |

Note: Slight method and coding variations can occur in different regions.

SELECT NICKEL METHODS

Nickel is used in stainless steels, metal alloys, plating, electric batteries and chemicals. It is found in either sulphide or laterite type ores so analytical methods are needed to ensure complete digestion.

Note: Refer to the Exploration-Grade Analysis section in this guide for descriptions of the 12B, 14B, 40B and 90A digestion techniques.

For descriptions of the 13B, 41Q, 42S and 90Q techniques, please see the Ore-Grade Analysis section, and for 06V and 07V refer to the Control-Grade Analysis section.

EXPLORATION-GRADE NICKEL METHODS

| CODE(S) | LIMIT(S) | DESCRIPTION |
|--|--------------|---|
| GE ICP12B / GE ICP14B GE_ICP22B20 / GC_ICP21B20 | 1 ppm - 1% | 2-Acid digest / Aqua regia – ICP-AES |
| GE IMS12B / GE IMS14B GE_IMS22B20 / GE_IMS21B20 | 0.5 ppm - 1% | 2-Acid digest / Aqua regia – ICP-MS |
| GE ICM12B / GE ICM14B | 0.5 ppm - 1% | 2-Acid digest / Aqua regia – ICP-AES / ICP-MS |
| GE ICP40B GE_ICP40Q12 | 1 ppm - 1% | 4-Acid digest – ICP-AES |
| GE ICM40B | 0.5 ppm - 1% | 4-Acid digest – ICP-AES / ICP-MS |
| GE ICP90A GE_ICP90A50 | 10 ppm - 10% | Fusion – ICP-AES |
| GE ICM90A | 5 ppm - 1% | Fusion – ICP-AES / ICP-MS |
| GE IMS90A GE_IMS90A50 | 5 ppm - 5% | Fusion – ICP-MS |

ORE-GRADE NICKEL METHODS

| CODE(S) | LIMIT(S) | DESCRIPTION |
|---------------------------|-------------|-----------------------------|
| GO ICP13B GO_ICP21B100 | 0.001 - 10% | Aqua regia digest – ICP-AES |
| GO ICP41Q GO_ICP42Q100 | 0.001 - 10% | 4-Acid digest – ICP-AES |
| GO AAS42S GO_AAS41S100 | 0.001 - 5% | 4-Acid digest – AAS |
| GO ICP90Q GO_ICP90Q100 | 0.01 - 30% | Fusion – ICP-AES |

CONCENTRATE-GRADE NICKEL METHODS

| CODE(S) | LIMIT(S) | DESCRIPTION |
|------------------------|-----------|---------------------------------|
| GC CON06V GC_CON06V | 5 - 65% | DMG separation / EDTA titration |
| GC CON07V GC_CON07V | 10 - 100% | DMG separation / electroplating |

* These methods can be done at party or umpire quality (GT). In these cases, the upper end of the reporting range will be 100%.

MINERAL SELECTIVE NICKEL METHODS

| CODE | LIMIT(S) | DESCRIPTION |
|---------------------------|----------|--|
| GO AAS03D GC_AAS03D250 | >0.002% | Metallic & sulphide nickel by bromine-methanol leach, AAS finish |

Note: Additional selective methods for nickel may be available. Please inquire.

ORES AND COMMODITIES

IRON ORE

SGS has unmatched XRF expertise at many of our laboratories. Iron ore is common in many mineral forms (hematite, magnetite, goethite, limonite or siderite) and analytical methods must be carefully chosen as iron minerals respond differently to various analytical methods. Borate fusion/XRF analysis is an extremely robust technique for major and minor element analysis in complex ores and offers highly precise and accurate results for iron ore samples. This method is not suitable for materials in which sulphide minerals exceed 1%.

BORATE FUSION / XRF IRON ORE PACKAGE (14 ELEMENTS)

GO XRF78S GO_XRF72

ELEMENTS AND LIMIT(S)

| | | | | | |
|--------------------------------|--------------|--------------------------------|--------------|-------------------------------|--------------|
| Al ₂ O ₃ | 0.01 - 100 % | MnO | 0.01 - 100 % | TiO ₂ | 0.01 - 100 % |
| CaO | 0.01 - 100 % | Na ₂ O | 0.01 - 100 % | V ₂ O ₅ | 0.01 - 100 % |
| Cr ₂ O ₃ | 0.01 - 100 % | P ₂ O ₅ | 0.01 - 100 % | SO ₃ | 0.01 - 100 % |
| K ₂ O | 0.01 - 100 % | Fe ₂ O ₃ | 0.01 - 100 % | LOI | 0.01 - 100 % |
| MgO | 0.01 - 100 % | SiO ₂ | 0.01 - 100 % | SUM | % |

Note: Additional minor elements can be added (As, Ba, Cl, Co, Cu, Ni, Pb, Sn, Sr, Ta, Zn and Zr). This method is available using robotic sample preparation as XRF78R in some SGS laboratories. This method is not suitable for samples with sulphide mineral contents > 1%. Please inquire.

VOLUMETRIC METHOD FOR IRON ORE

| CODE | ELEMENT | LIMIT(S) | DESCRIPTION | MIN. SAMPLE WT.(g) |
|------------------------|---------|----------|-------------|--------------------|
| GC CON08V GC_CON08V | Fe | 10 - 75% | Titration | 0.5 |

Note: these elements can be analyzed to party or umpire quality standards (GT) and can be reported up to 100%.

Magnetically susceptible minerals can be extracted from samples. Magnetic materials can be separated from nonmagnetic materials and materials with strong magnetic fields can be separated from materials with low magnetic fields. This property can be used to separate crushed iron ore at various stages of mineral processing.

The Satmagan test provides a measure of magnetic susceptibility, with results expressed as magnetic iron. The Davis Tube test also measures magnetic susceptibility, and can also separate various magnetic mineral phases. This allows for mass and elemental balancing.

SGS offers various magnetic separation techniques.

| CODE(S) | TECHNIQUE | DESCRIPTION |
|-----------------------|------------|---|
| GO PHY29V G_PHY20V | Satmagan | Measures the total magnetic moment in a saturated magnetic field to determine the percentage of magnetic material present |
| GO PHY28V G_PHY19V | Davis Tube | Separates and gravimetrically determines strongly magnetic particles from weak and non-magnetic particles |

URANIUM

SGS complies with all national licensing requirements associated with the safe handling and analysis of naturally occurring radioactive materials samples for transportation, workplace safety and environmental protection. The following analytical packages are specifically designed for uranium exploration and are offered at designated SGS laboratories.

Multi-element packages are listed in the Exploration-Grade Analysis section of this guide for low grade uranium analysis.

URANIUM PACKAGES FOR LOW GRADE MINERALIZATION

| CODE(S) | ELEMENTS/ LIMIT(S) | DESCRIPTION |
|---|----------------------|---|
| GE IMS12B / GE IMS14B GE_IMS22B20 / GE_IMS21B20 | U (0.05 - 10000 ppm) | 2-Acid / aqua regia digest / ICP-MS |
| GE ICM12B / GE ICM14B | U (0.05 - 10000 ppm) | 2-Acid / aqua regia digest / ICP-AES / ICP-MS |
| GE ICM40B | U (0.05 - 10000 ppm) | 4-Acid digest / ICP-AES / ICP-MS |
| GE ICM90A | U (0.05 - 1000 ppm) | Sodium peroxide fusion / ICP-AES / ICP-MS |
| GE IMS95A GE_IMS95A50 | U (0.05 - 1000 ppm) | Lithium metaborate fusion / ICP-MS |
| GE MMI-ME GE_MMIME | U (1 ppb) | Mobile Metal Ion Technology™ for soils |

Multi-element packages are listed in the Ore-Grade Analysis section of this guide. These methods are for medium to highly mineralized samples that include uranium analysis.

URANIUM PACKAGES FOR HIGHER GRADE MINERALIZATION

| CODE(S) | ELEMENTS/ LIMIT(S) | DESCRIPTION |
|---------------------------|--------------------|--|
| GO IMS91B GO_IMS91Q100 | 0.0001 - 1% | Sodium peroxide fusion / ICP-MS |
| GO XRF75F GO_XRF71 | 0.002 - 3% | Internal standard / XRF |
| GO XRF76B GO_XRF72 | 0.01 - 100% | Borate fusion with internal standard / XRF |

LITHIUM

SGS has the methodology to support exploration and production analysis of lithium. Multi-element packages are listed in the Exploration-Grade Analysis section of this guide for low grade lithium samples.

LITHIUM PACKAGES FOR LOW GRADE MINERALIZATION

| CODE(S) | ELEMENTS/ LIMIT(S) | DESCRIPTION |
|--|--------------------|---|
| GE ICP12B / GE ICP14B GE_IMS22B20 / GE_IMS21B20 | Li (1 - 10000 ppm) | 2-Acid / aqua regia digest / ICP-AES |
| GE ICM12B / GE ICM14B | Li (1 - 10000 ppm) | 2-Acid / aqua regia digest / ICP-AES / ICP-MS |
| GE ICP40B GE_ICP40Q12 | Li (1 - 10000 ppm) | 4-Acid digest / ICP-AES |
| GE ICM40B | Li (1 - 10000 ppm) | 4-Acid digest / ICP-AES / ICP-MS |
| GE ICP91A GE_ICP92A50 | Li (0.001 - 5%) | Sodium peroxide fusion / ICP-AES |
| GE ICM90A | Li (0.001 - 5%) | Sodium peroxide fusion / ICP-AES / ICP-MS |
| GE IMS90A GE_IMS90A50 | Li (0.0005 - 1%) | Sodium peroxide fusion / ICP-MS |

LITHIUM PACKAGES FOR HIGHER GRADE MINERALIZATION

| CODE(S) | ELEMENTS/ LIMIT(S) | DESCRIPTION |
|--------------------------|--------------------|----------------------------------|
| GC ICP91A GE_ICP92A50 | Li (>0.001%) | Sodium peroxide fusion / ICP-AES |

FLUORSPAR

SGS has the methodology to support testing of fluor spar material. Due to the nature of the test this scheme is only applicable to acid grade or other soluble fluor spar products.

SOLUBLE FLUORSPAR PACKAGE

| CODE(S) | ELEMENTS/ LIMIT(S) | DESCRIPTION |
|-----------|-----------------------------|----------------|
| GC_CLA37V | Ca (1-50%) | EDTA Titration |
| | CaCO ₃ (0.1-10%) | EDTA Titration |
| | CaF ₂ (10-100%) | calculation |

Note: For F results under 10%, CaF₂ can be determined by calculation from GC_ISE05V. Samples with Ca content greater than 25% may not be suitable for GC_ISE05V.

GRAPHITIC CARBON

SGS has the methodology to support testing of graphitic carbon.

GRAPHITIC CARBON PACKAGES

| CODE(S) | ELEMENTS/ LIMIT(S) | DESCRIPTION | MIN. SAMPLE WT. (g) |
|------------------------|-----------------------------|---|---------------------|
| GE_CSB05V GE_CSB05A | C graphitic (0.05%) | Coulometry | 0.2 |
| GC_CSA05V | C graphitic (0.05%) | Roast; HCl leach; IR Combustion | 0.4 |
| | C graphitic (>30%) | Roast; HCl leach; high temp IR combustion (*SC632) | 0.4 |
| GC_CSA06V | Total Carbon (<30%) | IR Combustion | 0.2 |
| GC_CSA06VH | Total Carbon (>30%) | High temp IR Combustion (*SC632) | 0.2 |
| G_ASH01 | **Ash content (0.01-10%) | Gravimetric | 20 |

Note: *SC632 high temperature IR combustion furnace provides greater precision for carbon >30%.

**Ash content is not a suitable measurement of graphite purity for samples containing carbonates or other non-graphitic carbon species and is only recommended for samples >90% graphite.

IMPURITIES FOR GRAPHITIC CARBON (12 ELEMENTS)

GC ICP95A

ELEMENTS AND LIMIT(S)

| | | | | | |
|----|---------|----|---------|----|---------|
| Al | 10 ppm | K | 8 ppm | P | 20 ppm |
| Ba | 0.3 ppm | Mg | 3 ppm | Si | 30 ppm |
| Ca | 10 ppm | Mn | 0.4 ppm | Ti | 0.8 ppm |
| Fe | 20 ppm | Na | 5 ppm | Zr | 0.3 ppm |

Requires a minimum sample weight of 20 g.

Note: Trace impurities are determined by lithium metaborate fusion with ICP-AES analysis on residue obtained by ashing (G_ASH01). Additional impurity elements are available upon request.

Graphitic carbon and impurity analysis is not available at all SGS locations, please inquire.

SGS offers a wide selection of analyses for ores, commodities and concentrates specific to your needs. The following list additional selections, and others are available. Please inquire.

- Manganese ores
- Aluminium ores (bauxite, including extractable SiO₂, Al₂O₃, reactive Si, available Al)
- Tantalum ores
- Industrial minerals (limestone, chromite, borate)
- Fertilizers products (phosphate, sulphur, potash)
- Concentrates and metals
- Mineral sands

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 | | | | | | |
| 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 | 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

MINERALOGY SERVICES

High Definition Mineralogy is the expert quantitative study of minerals using automated techniques. SGS is the world leader in providing comprehensive automated High Definition Mineralogy to the global minerals industry and other market sectors that need detailed material, product or residue characterizations.

SGS' world-class team of mineralogical professionals provides a significant interpretive value to the High Definition Mineralogy product at every stage of your project. Our expertise, years of experience and comprehensive capabilities allow us to provide crucial input into your strategic decisions, giving you the competitive advantage you need.

While we can support investigations and interpretations of mineralogical data in many industries, we specialize in applications rooted in the exploration and mining industry. High Definition Mineralogy can provide important insights at the acquisition, exploration, prefeasibility, feasibility and operational levels:

SUPPORT FOR MINERAL EXPLORATION AND RESOURCE DELINEATION

Our EXPLOMIN™ products can help map the bulk mineralogy and ore textures with property development. Automated trace mineral searches are also available to identify precious or rare minerals including gold. We can also provide mineralogical, liberation and deportment data and interpretation in support of geometallurgical programs.

SUPPORT FOR METALLURGICAL OPERATIONS AND PLANTS

Our ore characterization and process mineralogy offerings provide detailed snapshots of the factors that influence grindability and metallurgical recovery. Such data is used to support flowsheet development for grassroots start-ups, metallurgical accounting for on-going operations and to benchmark plants during audits and troubleshooting programs.

SUPPORT FOR ENVIRONMENTAL CONSIDERATIONS

SGS provides the identification and deportment (texture) of minerals or phases in natural or industrial environments to:

- Support environmental programs (composition of waste rock, tailings and soils).
- Map deleterious mineral assemblages (As, Pb, Se).
- Establish sources of contaminants using forensic determinations.
- Analyze environments for industrial hygiene purposes (respirable silica and asbestos determinations).

SGS' team of applied and process mineralogists are experienced in the evaluation of ore samples and metallurgical products from a wide variety of commodities. Our Advanced Mineralogy Facilities are equipped with a wide variety of mineralogical equipment and techniques including:

- QEMSCAN®.
- X-ray diffraction (XRD).
- Scanning electron microscopy (SEM).
- Electronic microprobe.
- Optical mineralogy.

Refer to Rocks to Results, Section 5, and www.sgs.com/mining/mineralogy for additional information.

METALLURGY SERVICES

SGS's demonstrated success in metallurgical and process design has provided thousands of companies with effective flowsheets and practical technical solutions to processing problems. From that core of capability, we continue to provide the processing industry with innovative approaches to geometallurgy, process modeling, production forecasting and advanced control systems.

The major activities of SGS's mineral processing, metallurgy and process design experts include:

- Integrated analytical and mineralogical analysis.
- Risk mitigation using geometallurgical solutions.
- Development of environmentally sustainable processes and flowsheets for recovery and purification of pay metals.
- Confirmation of flowsheets via pilot plant testing programs.
- Development of new and innovative technologies for complex ore processing.
- Generation of engineering data for plant design purposes.
- Chemical engineering and process design for production facilities.

- On-site technical evaluations and audits.
- Evaluation and installation of advanced process control using expert systems.
- Evaluation and stabilization of discharge streams and waste products.

SGS provides solid, reliable, reputable, independent solutions for:

- Scoping studies.
- High Definition Mineralogy.
- Flowsheet development.
- Cyanidation technologies.
- Sustainable process development.
- Geometallurgy.
- Pilot plants.
- Bulk sample processing and market sample creation.
- Engineering data generation and modeling.
- Particulate testing.

For more information on the extensive range of bankable metallurgical services offered by SGS, please visit www.sgs.com/metallurgy.

GEOLOGICAL SERVICES

With over 35 years of experience providing the mining industry with computer-assisted mineral resource estimation services using cutting edge geostatistical techniques; SGS Geological Services is known globally as the expert in ore body modeling and reserve evaluation. We bring the disciplines of geology, geostatistics, and mining engineering together to provide you with accurate and timely mineral project evaluation solutions. We also offer a broad range of services to the mining and exploration industries to reduce risk and enhance value. We have the expertise to assist you in the following areas:

- Exploration services including customizable software solutions
- Ore body modeling and resource estimation within our own GENESIS software

- Mine engineering including optimization, design and scheduling
- Mine audits including resources, reserves, mine to plant reconciliation and technical due diligence
- Desktop studies and Technical Reports (NI 43-101, JORC and SAMREC)
- Sample Selection for metallurgical tests to ensure representability
- Training and education on themes discussed above

With over 1000 consulting projects completed worldwide, SGS Geological Services is well equipped to minimize your operational and financial risks. You can depend on SGS Geological Services global technical leadership to ensure effective solutions to your exploration and mining challenges.

As part of the larger SGS Minerals group, we can draw upon our massive network of laboratories, metallurgists, process engineers and other professionals to help bring your mineral project to the next level.

GEOLOGICAL MODELING

At SGS Geological Services, an orebody modeling project starts with a critical review of geological interpretation according to existing drill hole and surface or underground data and maps. Drill hole and/or sample databases are constructed along with all the quantitative and qualitative information available to build a resource model. Many tools have been developed in our specialized software (GENESIS) including implicit modelling, variable ellipsoids and “fast-mode” modelling. These features provide rapid and flexible modelling solutions providing the Geostat team with an edge.

GEOSTATISTICS AND RESOURCES ESTIMATION

Accurate resource estimation by a Qualified Person (QP) is an essential part of due diligence, and is the corner stone of international reporting standards such as National Instrument 43-101 and JORC. SGS Geological Services is an experienced leader in geostatistical techniques and will ensure your resource estimations are completed with the utmost accuracy and integrity. Geostatistics involves the analysis and prediction of the spatial distribution of materials within the earth based on the concept that variability is predictable within a specific ore domain. One of the most important tools utilized to establish these relationships are variograms. The raw data is compiled validated and imported into our proprietary software to calculate variograms; these enable the characterization of the nugget effect and the inherent variability of data in specific directions within the ore domain. Careful construction of the variogram also enables

various types of sophisticated algorithms to estimate grades into block models; including kriging (simple, ordinary, lognormal or indicator) and conditional simulations. There are several advantages to using these advanced methods of interpolation:

- Retention of high-nugget samples during interpolation to minimise metal loss due to smoothing or capping
- Reduce the overall error in resource and reserve estimation
- Quantification of error and even the probability that a given stope or open pit blast of being below the cut-off grade

For more information on the services provided by our SGS Geostats team, visit www.geostat.com

CONVERSION FACTORS

US STANDARD TEST SIEVE SERIES

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

FREQUENTLY REQUESTED EQUIVALENTS

| % | G/T (GRAMS / METRIC TONNE) | MG/KG | µG/KG | PPM | PPB |
|--------|----------------------------|--------|------------|--------|------------|
| 1 | 10,000 | 10,000 | 10,000,000 | 10,000 | 10,000,000 |
| 0.1 | 1000 | 1000 | 1,000,000 | 1000 | 1,000,000 |
| 0.01 | 100 | 100 | 100,000 | 100 | 100,000 |
| 0.001 | 10 | 10 | 10,000 | 10 | 10,000 |
| 0.0001 | 1 | 1 | 1000 | 1 | 1000 |

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 |
| PQ | 85.0 | 3.345 | 5.67 | 105.5 |

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 | 0.0327 |
| 1 Troy oz / short ton | 34.286 | 34286 | 1.1023 | 1 | 1.12 |

SGS MINERALS LOCATIONS

GEOCHEMISTRY CONTACTS

AUSTRALIA

KALGOORLIE

17 Stockyard Way, Broadwood, WA, 6430
Tel: + 61 (08) 9021 2911
au.kalgoorlielab@sgs.com

PERTH

28 Reid Rd., Perth Airport, WA, 6105
Tel: + 61 (0)8 9373 3500
au.newburnlab@sgs.com

TOWNSVILLE

50 Leyland St., Garbutt, QLD, 4814
Tel: + 61 (0)7 4725 2311
au.townsvillelab@sgs.com

WEST WYALONG

Lot 9, Gelling St., West Wyalong, NSW, 2671
Tel: + 61 (0)2 6972 1211
minerals@sgs.com

ARGENTINA

ARGENTINA

2580, Monseñor Tavella Avenue, Salta Capital, Argentina
Tel: (+549) 011 3875001739
minerals@sgs.com

BRAZIL

BELO HORIZONTE

SGS Geosol Laboratorios Ltda, Rodovia MG 010, Km 24, 5
Bairro Angicos 33200-000 - Vespasiano - MG
Tel: + 55 31 30450200
minerals@sgs.com

BURKINA FASO

OUAGADOUGOU

Zone Industrielle de Kossodo
11 BP: 565 Ouagadougou 11
Mob: + 226 70 21 21 02
minerals@sgs.com

CANADA

COCHRANE

1 First Ave., Cochrane, ON P0L 1C0
Tel: + 1 705 272 2559
minerals@sgs.com

LAKEFIELD

185 Concession St., Lakefield, ON K0L 2H0
Tel: + 1 705 652 2000
minerals@sgs.com

RED LAKE

16A Young St., Red Lake, ON P0V 2M0
Tel: + 1 807 727 2939
minerals@sgs.com

SUDBURY

1209 O'Neil Drive W., Sudbury, ON P3L 1L5
Tel: + 1 705 693 4555
minerals@sgs.com

VANCOUVER

3260 Production Way, Burnaby, BC V5A 4W4
Tel: + 1 604 638 2349
minerals@sgs.com

CHILE

ANTOFAGASTA

Av. El Cobre #400 Parque Industrial, La Negra, Antofagasta
Mob: + 56 99 8680857
minerals@sgs.com

SANTIAGO

Puerto Madero 9600, Parque Industrial Puerto Santiago
Pudahuel – Santiago
Mob: + 56 99 8680857
minerals@sgs.com

CHINA

TIANJIN

SGS Mansion, No. 41, The 5th Ave., TEDA, Tianjin, 300457
Tel: + 86 (0) 22 6528 8209
minerals@sgs.com

URUMQI

No. 82, Nanyixiang, Huangshan St.
2nd Development Area, Urumqi, XJ, 830026
Tel: + 86 (0) 991 3775351
minerals@sgs.com

COLOMBIA

MEDELLIN

Carrera 52 N° 14 Sur 26, Medellin
Mob: + 57 4 3201080
minerals@sgs.com

DEMOCRATIC REPUBLIC OF THE CONGO

LUBUMBASHI

No. 006838, Route Likasi, Quartier Jolie Site
Commune Annexe, Ville de Lubumbashi
Lubumbashi, Haut Katanga
Mob: + 243 8130 77538
minerals@sgs.com

GHANA

TARKWA

Jerusalem Junction, Bankyim, Tarkwa
Western Region, P.O. Box 38, Tarkwa
Mob: + 233 (0) 24 432 3404
minerals@sgs.com

INDONESIA

JAKARTA

Sentra Industri Terpadu, Pantai Indah Kapuk
Blok E2 No. 28, 29, 37, 38, Jalan Kamal Muara VII, Jakarta Utara
Mob: + 62 21 5698 2898
minerals@sgs.com

MALAYSIA

PORT KLANG (NEAR KUALA LUMPUR)

Wisma SGS, Lot 603, Leboh Raja Lumu
Kawasan Perindustrian PKNS, Pandamaran
Port Klang, Selangor, 42000
Tel: + 60 3 3165 2320
minerals@sgs.com

MALI

BAMAKO

Zone Industrielle Sotuba, Rue 947, Porte 213, BPE 2514 Bamako
Mob: + 223 66 74 62 39
minerals@sgs.com

MEXICO

DURANGO

Antimonio #121 Cd. Industrial, Durango, CP 34208
Mob: + 52 1 618 125 1819
minerals@sgs.com

MONGOLIA

ULAANBAATAR

Uildveriin toirgiin 101 toot, Bayangol district 20th khoroo, Ulaanbaatar 36
Tel: + 976 7014 4415
minerals@sgs.com

NEW ZEALAND

WAIHI

43 Victoria St., Waihi, 3610, P.O. Box 135, Waihi, 3641
Tel: + 64 7 863 8969
minerals@sgs.com

WESTPORT

5 Lyttelton St., Westport, P.O. Box 240, 7866
Mob: + 64 3 788 9003
minerals@sgs.com

PAKISTAN

KARACHI

H3/3 Sector #5, Korangi Industrial Area, Karachi, 74900
Tel: + 92 21 3512 1388
minerals@sgs.com

PERU

LIMA (CALLAO)

Ave. Elmer Faucett, 3348, Callao 1 (Lima)
Tel: + 51 1 517 1900
minerals@sgs.com

RUSSIA

CHITA

5 Malaya St., 672014, Chita
Tel: + 7 (3022) 31 46 44
minerals@sgs.com

SOUTH AFRICA

ALLANRIDGE (NEXT TO TARGET MINE)

2 Buffalo St., Allanridge, Free State, 9490
Tel: + 27 (57) 451 3412
minerals@sgs.com

BARBERTON

Rusplaas, Noordkaap, Barberton, Mpumalanga, 1300
Tel: + 27 (13) 719 9775
minerals@sgs.com

RANDFONTEIN

Zuurbekom Rd., Next to Cooke Recovery Plant Randfontein, Gauteng, 1760
Tel: + 27 (0) 79 841 5877
minerals@sgs.com

RUSTENBURG

1 Ferro Street, Industrial Area, Rustenburg, 0299
Tel: + 27 (0) 14 592 1654/8273
minerals@sgs.com

TANZANIA

MWANZA

Nyanza Glass Works, Shinyanga Rd., Mwanza
Tel: + 255 28 2550861
minerals@sgs.com

TURKEY

ANKARA

Ankara 1. Organize Sanayi Bölgesi
Orhan Isik Cad No:11 Sincan Ankara, 06935
Mob: + 90 533 020 2149
minerals@sgs.com

ZAMBIA

KALULUSHI

SGS Kalulushi Chibuluma Business Park, Kalulushi
Tel: + 260 (212) 730045 / 46
minerals@sgs.com

METALLURGY CONTACTS

AUSTRALIA

PERTH

431 Victoria Rd., Malaga, WA, 6090
Tel: + 61 (0)8 9209 8700
minerals@sgs.com

BRAZIL

BELO HORIZONTE

SGS Geosol Laboratorios Ltda, Rodovia MG 010, Km 24, 5
Bairro Angicos 33200-000, Vespasiano, MG
Tel: + 55 31 30450200
minerals@sgs.com

CANADA

LAKEFIELD

185 Concession St., Lakefield, ON K0L 2H0
Tel: + 1 705 652 2000
minerals@sgs.com

QUEBEC

125 rue Fortin, Suite 100, Québec, QC G1M 3M2
Tel: + 1 418 661 6624
minerals@sgs.com

TORONTO

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

BURNABY (VANCOUVER)

3260 Production Way, Burnaby, BC V5A 4W4
Tel: + 1 604 638 2349
minerals@sgs.com

CHILE

SANTIAGO

Puerto Madero 9600, Parque Industrial Puerto Santiago, Pudahuel – Santiago
Tel: + 56 2 898 9100
minerals@sgs.com

PERU

LIMA (CALLAO)

Ave. Elmer Faucett, 3348, Callao 1 (Lima)
Tel: + 51 1 517 1900
minerals@sgs.com

RUSSIA

CHITA

5 Malaya St., 672014, Chita
Tel: + 7 (3022) 31 46 44
minerals@sgs.com

SOUTH AFRICA

BOOYSENS-JOHANNESBURG

259 Kent Ave., Ferndale, Randburg
Mob: + 27 (0) 82 894 4165
minerals@sgs.com

ENGINEERING SERVICES CONTACTS

SOUTH AFRICA

JOHANNESBURG

SGS Bateman (Pty) Ltd
Woodmead North Office Park
54 Maxwell Drive, Waterfall 2191
Tel: + 27 11 100 9100
bateman@sgs.com

UNITED STATES

TUCSON

3845 N. Business Center Dr., Suite 111, Tucson, AZ, 85705
Tel: + 1 520 579 8315
bateman@sgs.com

WWW.SGS.COM

WHEN YOU NEED TO BE SURE

