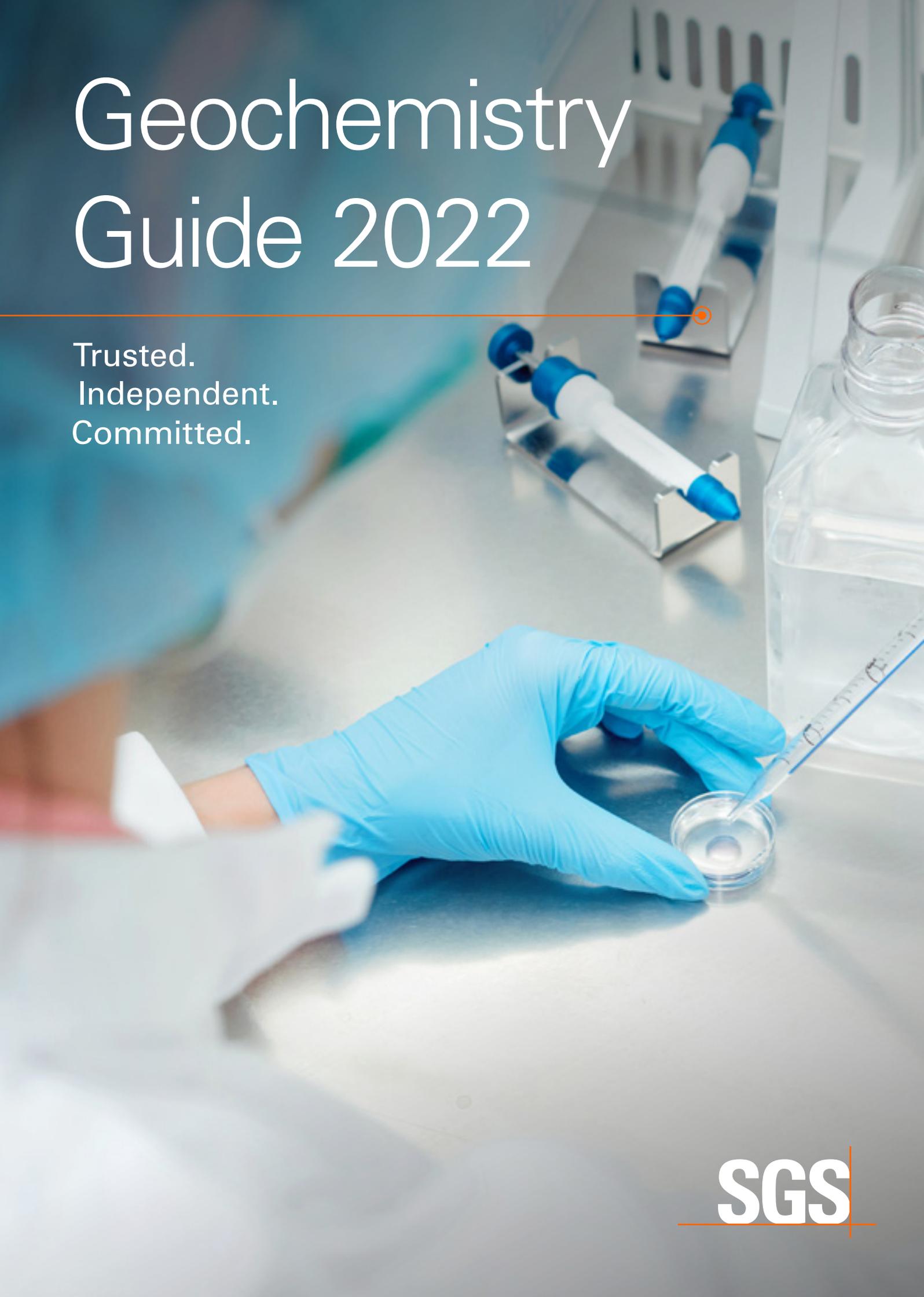


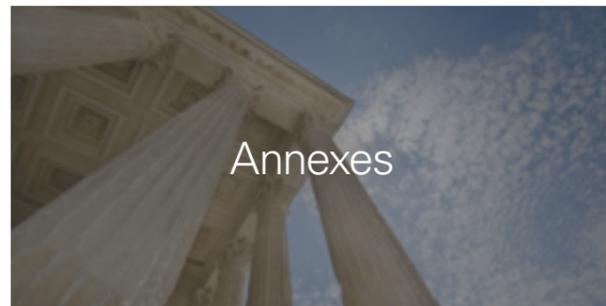
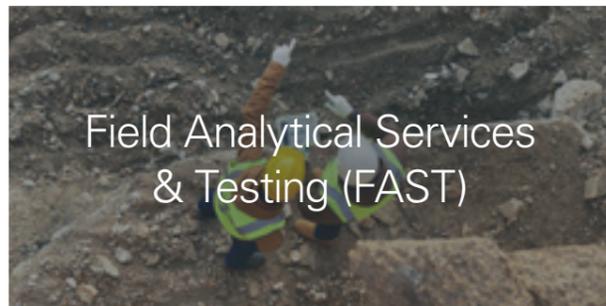
Geochemistry Guide 2022

Trusted.
Independent.
Committed.



SGS

Contents



Introduction



LAWRENCE NG
VICE-PRESIDENT
GEOCHEMISTRY COMMERCIAL

ANDREW PICKERING
VICE PRESIDENT
GEOCHEMISTRY ON-SITE

The exploration and mining industries are facing more technical and operational challenges than ever before. The fit for purpose sample preparation and analytical methodology to deliver accurate information becomes more critical to make timely decision to advance the program. Whether it is precious, base, battery metals, REE or bulk commodities, SGS Geochemistry's expertise offers technical and operational advice for your project. As the leader in Geochemistry Analytical Services, SGS provides a global network of experts. Our one team approach is ready to be your strategic and sustainable partner.

As the growth of the minerals and mining sector accelerates, SGS continues its leadership role in on-site geochemistry testing. Our focus on safety, quality, innovation and delivery has allowed SGS to develop the largest global network of on-site mine, exploration and smelter support operations. These laboratories provide essential data for the development and operation of the projects and plants they support.

As we continue to develop our Field Analytical Services and Testing (FAST) suite of services we leverage next generation technologies in pXRF, FTIR, pNIR, core analysis and photography to provide you specific analytical solutions to meet your needs. Furthermore, we continue to see increasing interest in our Mobile Sample Preparation Units (MSPU) that provides sample reduction on-site limiting assay TAT and shipping cost.

SGS looks forward to another year of prosperous and trustful collaboration in 2022.



About SGS

We are recognized as the global benchmark for quality and integrity. Our 93,000 employees operate a network of 2,600 offices and laboratories, working together to enable a better, safer and more interconnected world. Wherever you are, whatever your industry, our experts worldwide provide specialized solutions to make your business faster, simpler and more efficient.

Today, we provide worldwide, independent services that make a difference to people's lives. Our training and consultancy services complement our core business of testing, inspection and certification which are delivered across all industries.

Through our unique global network, we deliver independent results tailored to the precise needs of each industry or sector. Our customers trust in our expertise, experience and resources to support them in achieving outstanding performance in everything they do.

Our continued focus on innovative ways to deliver business benefits enables us to help our customers improve quality, safety, efficiency, productivity and speed to market while reducing risk and building trust in sustainable operations.

2020 HIGHLIGHTS :

CHF 6579 MIO

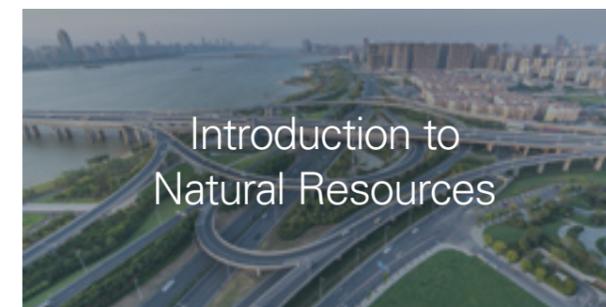
value to society calculated in 2020

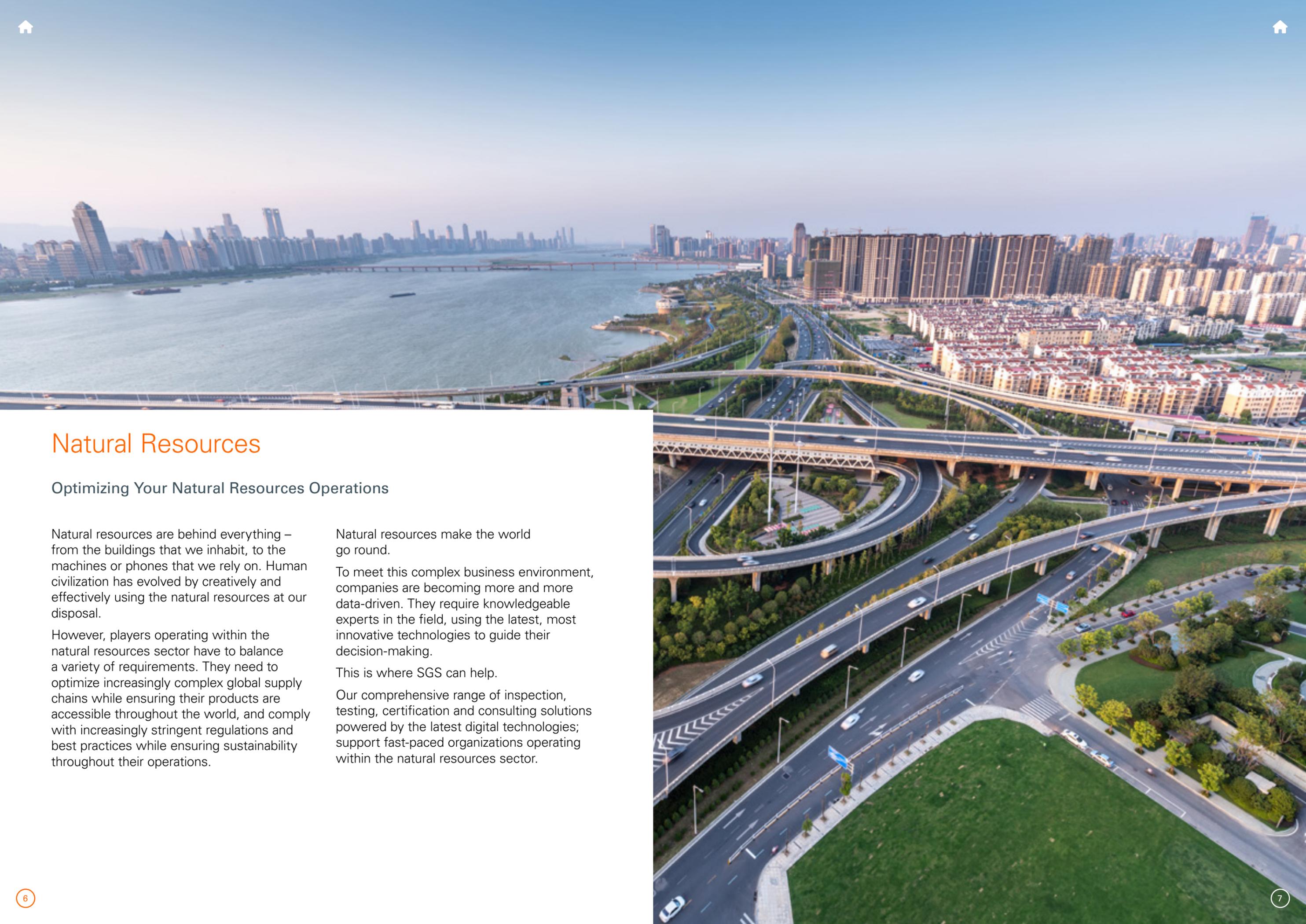
AAA rating

(Morgan Stanley Capital International's (MSCI) Environment Social Governance)

Carbon Neutral

SGS Solutions





Natural Resources

Optimizing Your Natural Resources Operations

Natural resources are behind everything – from the buildings that we inhabit, to the machines or phones that we rely on. Human civilization has evolved by creatively and effectively using the natural resources at our disposal.

However, players operating within the natural resources sector have to balance a variety of requirements. They need to optimize increasingly complex global supply chains while ensuring their products are accessible throughout the world, and comply with increasingly stringent regulations and best practices while ensuring sustainability throughout their operations.

Natural resources make the world go round.

To meet this complex business environment, companies are becoming more and more data-driven. They require knowledgeable experts in the field, using the latest, most innovative technologies to guide their decision-making.

This is where SGS can help.

Our comprehensive range of inspection, testing, certification and consulting solutions powered by the latest digital technologies; support fast-paced organizations operating within the natural resources sector.



Geochemistry

Unparalleled analytical support, where and when you need it

SGS provides analyzes on a wide range of geological materials containing precious, base, rare earths and battery metals, as well as bulk commodities, like bauxite and iron ore. Whether you are exploring green or brown field sites, assessing feasibility or setting up mine operations, we can support all your geochemistry needs. Our network of commercial, mobile and mine-site laboratories provides consistency across an unparalleled number of countries and mining camps. Our one team approach incorporates a global

network of experienced managers and highly skilled assayers, utilizing state-of-the-art equipment to provide you with accurate analysis at fast turnaround times. We are available where and when you need us.

As the leading service provider to the mining sector, we deliver quality and trusted data, while meeting the required turnaround times of our clients.

We offer a wide range of solutions to support you along your journey

We are committed to customer satisfaction and providing a consistent level of quality service that sets the industry benchmark. Our unrivaled expertise and experience support you both as a strategic partner and technical advisor.

Our team of local experts supported by a network of state-of-the-art laboratories will help you optimize your operations by providing:



Commercial and on-site laboratories



Field Analytical Services and Testing (FAST)



Proficiency testing



Customized Laboratory operations at your site

Efficient and financially viable mining operations require accurate and reliable data to help managers optimize their processes and ensure contractual and regulatory compliance.

With a global network of specialists, we are ready to help support you with advanced on-site geochemical analysis. From exploration to operation, our on-site teams provide data that will help you gain the high-level insights you need to make informed management decisions. Our services allow you to fine-tune every stage of your value chain with solutions that support exploration, mining, mill and plant operations, smelting, and tailings disposal.

Gain flexibility and a competitive edge when you use our on-site or mobile laboratory services:

- Benefit from fast turnaround and accurate data
- Avoid project delays and reduce shipping delays
- Focus on the core aspects of your operation and allocate resources more effectively
- Take advantage of our technical expertise and experience in real-time

Our on-site laboratories give you access to trusted, third-party analysis – no matter how remote the location is.

Our analytical services give you greater insight

Commercial viability for your mining operation requires detailed characterization of your ore body and optimized mineral processing.

We provide a wide range of analytical methods to help you quantify your mineral resource and check extraction processes – from grade control for minimizing dilution during mining to process control in the plant.

With a global network of specialists, backed by state-of-the-art testing facilities, we provide you with valuable data at various stages of your mining project. Our range of analytical tools support you in the discovery phase, using feasibility studies, and during operations, to ensure you have the right systems in place to improve recovery and properly monitor tailings and waste rock.

We are recognized as the global benchmark for quality and integrity. Wherever you operate in the world, our industry-recognized experts are available to help you make informed decisions that optimize your operation.

From sample preparation to exploration, ore- and control-grade analysis, we offer tailored packages and custom service offerings to meet all your unique needs.



Bring quality laboratory analysis to the field

During exploration, resource definition and production, getting analytical data quickly is vital for making accurate and timely decisions. Field Analytical Services and Testing (FAST) provides you with essential analytical data within 24- to 48-hours from the sampling event using new portable analytical technologies. This dedicated field-based preparation and analytical testing gets you the data you need to make quick, but accurate decisions around exploration, mining and plant production.

FAST enables you to:

- Make informed operational decisions supported by site-customized data
- Optimize your spending on geochemistry by sorting and prioritizing samples for laboratory testing in the field
- Quickly determine grade, stockpile, and process control during production

We are committed to delivering the same high-quality sample analysis in our FAST approach as found in our commercial laboratories.

Technologies are calibrated to your deposit, and methods and detection limits are reviewed and validated regularly to ensure that data quality objectives are being met and maintained.

FAST brings the laboratory to the field, no matter how remote you are, and provides accurate data within 24- to 48-hours of sampling – enabling true speed-to-market.



Proficiency testing for geochemistry

Through specialized proficiency testing programs (PTPs), SGS Laboratory Quality Services, International (LQSi) offers quality assurance that is required of laboratory certified to the ISO/IEC 17025 standard. Our ISO 17034:2016 laboratory provides objective evidence that supports your ability to meet the ever-increasing demands of laboratory quality management systems developed by national, international and industry standards organizations. Proficiency testing data can also be used to demonstrate your laboratory's competence to prospects, customers, shareholders and other entities that are critical to the success of your business. All laboratory data and methods submitted to SGS LQSi are privileged information. We assure that your identity and proprietary information will not be released to a third-party without your prior knowledge and written authorization.

Through LQSi we ensure your laboratory meets the ever-increasing demands of laboratory quality management systems developed by international, national, and industry standards organizations.



Metallurgy & Consulting

Realize the full value of your mineral deposit

Our team of highly qualified professionals provide solutions that are innovative, reliable and effective. We have an extensive network of technical experts who work across the project lifecycle from exploration through to closure to seamlessly integrate metallurgical testwork, pilot plant testing, feasibility studies and engineering, to find practical, cost-effective solutions that will help you get the most from your project or operation.

Our disciplines include:



Geology and mining engineering



Metallurgy and mineralogy



Feasibility studies and engineering



Geometallurgy and process optimization



Process audits and metal accounting



Advanced process control systems

Mineral & Metal Commodities

Facilitating the global minerals and metals supply chain

Our global network of qualified inspectors and laboratory technicians will accurately and swiftly determine the quality and quantity of your commodities. Our international risk management experts will help you to identify and minimize any potential risks associated with your business. Benefit from our most accurate market intelligence data to aid decision-making, giving you a competitive advantage in the market.



Testing



Inspection



Risk management



Market intelligence



How to use the Geochemistry 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 minimum number of methods you need so you can maximize your analytical dollar.

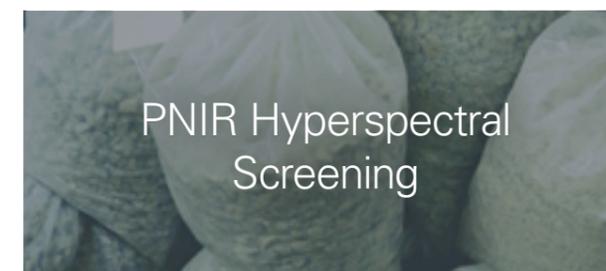
This guide outlines the most common procedures required by the geological community. Regional capabilities can differ throughout the SGS network based on available equipment and expertise. Contact your regional customer services representative for details and pricing. Samples can be submitted to any analytical laboratory, through our on-line submission form in the

Annexes, 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 to another laboratory, 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 analytical needs.

On-Site Testing Laboratories

Content





Optimizing Mine Efficiency Through Reliable Data

Efficient and financially viable mining operations require accurate and reliable data to help managers optimize their processes and ensure contractual and regulatory compliance.

With a global network of specialists, we are ready to help support you with advanced on-site geochemical analysis. From exploration to operation, our on-site teams provide data that will help you gain the high-level insights you need to make informed management decisions. Our services allow you to fine-tune every stage of your value chain with solutions that support exploration, mining, mill and plant operations, smelting, and tailings disposal.

These include:

- Exploration & mine support
- Mill & plant support
- Smelter support
- Hybrid laboratories
- Mobile Sample Preparation Units (MSPU)

Our services can be customized to your individual requirements and are delivered by industry recognized experts. Whatever your requirements and wherever you operate, we can help you to develop and implement the right on-site laboratory for your operation.



Portable XRF (pXRF) (Chemistry / Elemental Analysis)

SGS offers a range of analytical techniques which generate indicative assay results, making use of a generic calibration setup and generic Quality Control samples (mid to low mineralized sediment, mineralized mine rock) with a wide analytical range. Portable XRF is the ideal technique for screening large volumes of samples for a comprehensive element range, and concentration ranges spanning exploration to ore grade mineralization(s). Highly mineralized samples, process feeds, materials and concentrates can also be screened either in the sample bag, or as prepared pulp. This flexibility allows its use throughout the whole mining cycle, from exploration, to process control to remediation.

SGS has partnered with Bruker and Olympus, to offer pXRF with client specific calibrations, which are superior to the traditional type standardization approach. This allows for a wider operating range, and can model the mineralogical and grain size range of the specific material.

For high grade ore, process materials and concentrates, it is recommended that a quality control setup be implemented. This will mitigate the high risk of inaccurate results, as well as false positives. When analyzing materials in the sample bag, the analysis needs to be calibrated for the respective bag used. It is also imperative that all samples are in the same type/model bag. Some elements such as Ca, S, Ti, Zn might be part of the composition of the sample bag, which limits their detection in the sample.



For larger volumes of samples, SGS offers a customized matrix matched setup, which is site specific. This includes range-targeted Quality Control materials to allow for JORC compliance, as well as consistent input for geochemical modelling and machine learning.

These applications are also adjusted and continuously monitored to ensure the highest consistency and prompt reaction to any mineralogical change. Historical measurement data can also be reprocessed with the updated application, to further increase data quality and additional elements can also be added.

As part of the FAST offering, the on-site analytical techniques, including pXRF, can be

deployed to the client site or a designated SGS preparation laboratory. The FAST project techniques are all set up to be matrix or site specific. The SGS Quality Control calibrations are traceable, with either matrix matched reference material (MMRM) or site specific reference material (SSRM). The application is continuously checked by performing confirmation analysis on 5-20% of the site samples at an SGS commercial laboratory. This confirmation analysis can also be used to improve a generic calibration to a site-specific calibration.

Please [contact](#) the Customer Service representative for your region for more information and advice on selecting the method and application for your project.

Exploration/Soil pXRF Package

GE_PXRF73GEO

Pulp based measurement for rocks, sediments, RC drill cuttings and crushed core for litho geochemistry. Sediment samples are used as Quality Control. Go to [Exploration Grade XRF Analysis](#) for elements and reporting limits.

GE_PXRF73SOIL

Soil, sediments and till samples that are dried, delumped and screened at 180 micron. Till and Sediments are used for Quality Control. Go to [Exploration Grade XRF Analysis](#) for elements and reporting limits.

GE_PXRF73CONC MINING MATERIAL CONCENTRATES/PRODUCTS

Pulp measured through a paper or plastic bag or as powder mount. Indicative results reported and adjusted for attenuation of the bag when used. Elements common with bag material (i.e., Ca, Ti) are not reportable. Matrix matched Quality Control Sample. Go to [Exploration Grade XRF Analysis](#) for elements and reporting limits.

GE_PXRF73MIN

Pulp based measurement for mineralized rocks and sediments, RC drill cuttings, crushed core, feeds, and concentrates in a loose powder setup. Go to [Exploration Grade XRF Analysis](#) for elements and reporting limits.



Continuous EDXRF Core or Chip Tray Scanning

Unlike hyperspectral imaging which provides a signal which can be correlated to certain mineralogical phases, XRF based scanning provides a chemical assay which compares well against the traditional complete digest assays of a commercial laboratory without any sample preparation directly from the core or chips.

As XRF analyzes mostly the surface, integration of an area of 10cm or 1m will negate any inhomogeneity caused by the grainy assemblage of minerals and provide an assay close to the composite chemistry derived from cutting core and preparing it using traditional methods in a laboratory. Direct application of chemistry data in the logging process is well documented; this tool allows data integration at a very early stage of the process i.e. directly after the core has been taken.

Additional benefits include the ability to work on the data and use the deliverables to create a permanent record of the investment into the drill hole, especially when all material is slated for additional testing i.e. geo-metallurgical, pulp density or deportment analysis. Unlike point/spot analysis using pXRF, continuous scanning is made possible by using the patented method of constant distance scanning which in addition to chemical data also provides supplemental deliverables.

Scanning is performed at a constant distance from the sample surface, thus enabling correction for any air absorption. Integration intervals from 10cm to 1m or your custom requirements can be implemented. The analytical element range for this method is from Al to U. Rubble and cracks are skipped, ensuring that data is consistent for the quantification of the results and subsequent use in modelling.

Deliverables include:

- High resolution picture of dry core or chip trays (10 pixel/mm) under constant lighting conditions
- LIDAR based topography scan of the trays -> colorized with the picture to provide 3 D map of tray
- Chemistry as Quality Control CSV text file (weight %)
- Rock Quality Determination (RQD) index as cracks, rubble and scannable core are identified and tagged in the files
- Laser based accurate measuring of the core tray content
- Optional Specific Gravity (XSG) : XRF measured proxy calibrated against laboratory pycnometer SG

- Cloud based visualization and logging software with export functions into iOGAS™ and Leapfrog™ as well as ability to:
 - Share across teams and manipulation of the data
 - Free manipulation/zoom of 3 D tray and images down to mm level
 - Ability to log with chemical information overlapping 3-D core image
 - Structural logging (alpha/beta) by user on aligned core

Core scanning is a FAST offering for logging core at your facility or library, but is also available in selected SGS laboratories as a service. Similar to our pXRF offering, we have a number of different setups ranging from generic screening to custom site specific setups including confirmation analysis on pulp derived from the 1/2 or 1/4 core together with core slabbing and cutting all under one roof.

GE_EDX89G_AG GENERIC SETUP (AG EXCITATION)

	From (% wt)	to (% wt)	Info
Al	3	52	QC
As	0.0009	1	QC
Ba	0.008	10	Indic**
Bi	0.002	1	Indic**
Ca	0.01	70	QC
Cl	0.029	10	Indic**
Cr	0.002	68	QC
Cu	0.0012	10	QC
Fe	0.001	69	QC
Ga	0.0009	1	Indic**
K	0.030	70	*/QC
Mn	0.0018	77	QC
Nb	0.001	10	QC
Ni	0.003	20	QC
P	0.100	40	QC

*Interference with tube line

Indic.** Optional elements as indicative values only may be available at select locations with an additional Quality Control setup cost. Please enquire.

GE_EDX89G_CR

	From (% wt)	to (% wt)
Al	0.0142	52.0
As	0.0005	5.0
Ca	0.001	70.0
Cl	0.001	20.0 Indic**
Cu	0.002	10.0
Fe	0.01	69.0
K	0.001	70.0
Mn	0.01	77.0
Ni	0.005	20.0 Indic**, *

* Interference with tube line, spectral contamination

Indic.** Optional elements as indicative values only may be available at select locations with an additional Quality Control setup cost. Please enquire.

	From (% wt)	to (% wt)	Info
Pb	0.002	30	QC
Rb	0.0006	1	QC
S	0.03	40	QC
Sb	0.008	0.1	Indic**
Se	0.004	1	Indic**
Si	2.000	71	QC
Sr	0.0008	1	QC
Ta	0.001	10	Indic**
Te	0.008	0.1	Indic**
Ti	0.003	60	QC
U	0.0012	1	Indic**
V	0.001	56	QC
Y	0.001	1	QC
Zn	0.0011	10	QC
Zr	0.0008	10	QC



FOCUS ON ↓

PNIR Hyperspectral Screening

At selected SGS facilities, analysis of coarse material, pulp and solid samples (i.e. core) is offered, using pNIR instrumentation (i.e. ASD Terraspec™, Spectralevolution OreExpress™), covering the VNIR (380 – 1000nm) and SWIR1 and short wavelength infrared ranges 1001nm to 1800nm and 1800nm to 2500nm. A contact probe (solid/coarse) or diffuse reflectance probe (compacted pulp) is utilized. Stringent Quality Control of the unit and setup (regular white balance and polystyrene calibrations), as well as defined percentage

of repeats are standard. Quality Controlled data is ready for processing by either client or as part of a customized project by SGS. These services are also available as part of our FAST offering, on site or at preparation laboratories. This high-quality data can be used directly (as spectra) for machine learning applications, correlating it to metallurgical or “feed” properties. Additional deliverables are a selection of standard Skalars as well as the 2 to 3 most abundant IR active minerals in the VNIR & SWIR range.

GE_PNIR73SCAN pNIR Scan on coarse (<2mm) material (i.e. sample prep crusher split) using a contact probe diffuse reflectance probe including standardized Quality Control

GE_PNIR79SCAN pNIR Scan on solid core material using contact probe including standardized Quality Control

Focus on Mobile Sample Preparation Units (MSPU)

An SGS Mobile Sample Preparation Unit (MSPU) provides standardised sample preparation solutions to field-based mining activities. MSPUs reduce shipping costs and their related carbon footprint, and improve lead time on results by accessing expedited commercial assay capacity within the SGS laboratory network.

SGS installs standard, robust sample preparation equipment in containerized (portable) or trailer-mounted (mobile) facilities which are compliant with all industry HSE regulations and standards and with designs suitable for a range of climate conditions. SGS-designed MSPUs can be deployed to site to support 3 – 6 month drill campaigns or as a fixture to assist on-going, multi-year programs.

The dedicated preparation capacity enables our clients to ‘skip the line’ at SGS’ commercial assay laboratories as samples

arrive as pre-prepared pulps, immediately ready for analysis. Employing a local workforce in support of the communities we work in, our MSPUs are operated to SGS laboratory standards, and include our laboratory management system to ensure sample traceability and documented QA/QC compliance.

SGS has applied its decades of experience in onsite laboratory operation in remote locations, to create fit-for-purpose mobile sample preparation solutions to support a range of field-based mining activities, to provide the market with options to reduce operational costs associated with transport and to demonstrate corporate sustainability contributions through the associated reduced carbon footprint and increased contributions to local communities through additional employment opportunities.



FTIR For Quantitative Mineralogical Screening

Fourier-transform infrared spectroscopy (FTIR) is a technique used to obtain an infrared spectrum of absorption or emission of a solid, liquid or gas. The minerals that make up rocks and soils, each have a unique molecular structure. In minerals covalent bonding with i.e. C-H, O-H C=O etc., infrared radiation results in the vibration of the molecular bonds in the mineral. The intrinsic physiochemical property of these molecular bonds will provide a characteristic 'finger print' for the applicable minerals.

SGS has developed a set of FTIR applications using standard analytical pulp to determine the weight% of selected minerals using MID

range FTIR and a fixed optical path Attenuated Total Reflection (ATR) setup. This setup is ideal to screen large numbers of samples, as the analysis time is less than 2 minutes. While the generic analysis will provide indicative results, the matrix specific setups for certain minerals offer more accurate analysis including additional non-mineralogical parameters.

For larger volume of samples, SGS offers customized matrix matched and site specific setups, which can include process specific parameters. SGS in-house expertise can add value with rapid results to assist with your project.

EXPLORATION FTIR PACKAGE

GE_FTIR73BULK

MINERALS AND LIMIT(S)

Apatite 1 - 100%	Haematite 4.5 - 16.5	Quartz 1 - 100%
Biotite 1 - 40%	Illite 1 - 100%	Siderite 1 - 30
Calcite 1 - 100%	Kaolinite 1 - 100%	Smectite 1 - 100%
Dolomite 1 - 100%	K Feldspar 1 - 50%	Spodumene 1 - 100%
Goethite 1 - 20%	Muscovite 1 - 40%	



FOCUS ON ↓

Critical & Battery Metals

Understand critical and battery mineral deposits for efficient and compliant extraction. The novelty of critical and battery metals makes it important to gain a detailed understanding of the ore body before extraction. To achieve this, mining operations must employ a robust geometallurgical model of the mineralization based on sound analytical data. The insights gained through geometallurgy will help to ensure safety, environmental sustainability and economic viability.

Our range of expert geochemical and mineralogical solutions help you to identify and safely recover a wide range of metals, including cobalt, lithium and rare earth elements.

With state-of-the-art testing laboratories in all major markets and global expertise in mining, we can help you expedite the extraction of critical and battery metals in all corners of the world.



Commercial Testing Laboratory

Content



Sample Administration



Sample Preparation



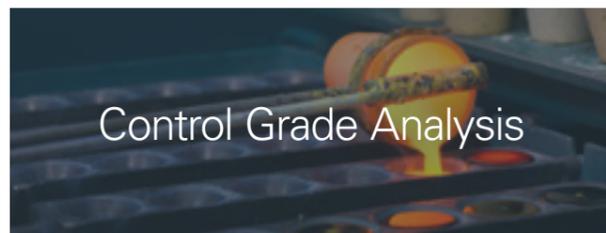
Exploration Grade Analysis



Ore Grade Analysis



Select Methods



Control Grade Analysis

Use data insights to make informed decisions

Commercial viability for your mining operation requires detailed characterization of your ore body and optimized mineral processing.

We provide a wide range of analytical methods to help you quantify your mineral resource and check extraction processes – from grade control for minimizing dilution during mining to process control in the plant.

With a global network of specialists, backed by state-of-the-art testing facilities, we provide you with valuable data at various stages of your mining project. Our experts perform high quality, multi-element analyzes that target a wide variety of elements in many types of sample matrices.

Our range of analytical tools support you in the discovery phase, using feasibility studies, and during operations, to ensure you have the right systems in place to improve recovery and properly monitor tailings and waste rock.

SGS is recognized as the global benchmark for quality and integrity. Wherever you operate in the world, our industry-recognized experts are available to help you make informed decisions that optimize your operation.



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 track and plan for your shipment.

We strongly recommend that all sample submissions be clearly labelled. Sample submissions that are poorly labelled or packaged can incur additional sorting charges.

All sample shipments require a completed sample submittal form or letter with clear instructions to avoid delays. Sample submission forms can be found on our website at [sgs.com/geochemistry](https://www.sgs.com/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 / or storage requirements.
- Unusual sample characteristics.
- Warning if any samples are potentially hazardous.

Some tips

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** the Customer Service representative for your region for more information and advice on selecting the method and application for your project.

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

CODE	ANALYTE CODE	DESCRIPTION
G_PKP		Sample collection/pickup
G_LOG		Sample sorting and registration
G_WGH_KG	WTKG	Sample weight as received
G_WGH_KG	DRYWTKG	Sample weight after drying
G_WGH_KG	BULWTIN	Bullion weight received
G_WGH_KG	BULWTOUT	Bullion weight after analysis



Sample tracking

All SGS laboratories run sophisticated LIMS systems, the SGS SLIM, which facilitates complete tracking of analyzes throughout the laboratory. SLIM directly tracks all samples from the time they are received at the preparation

facility until they are sent to a SGS Centre of Excellence, analyzed and reported. For more information about this process, please ask your local SGS laboratory.

Sample return, retention, storage and disposal

Pulp samples will be discarded after three months unless you specifically request on the sample submittal form to return or store. Storage fees will apply.

CODE	ANALYTE CODE	DESCRIPTION
G_DISP	RTN01	Return, pulp/rejects to client
G_RTV_HR		Retrieval and handling of samples for reanalysis
G_STORE	STO01	Store, cage, monthly rate
G_STORE	STO02	Store, bulka bag, monthly rate
G_STORE	STO03	Store, crate, monthly rate
G_STORE	STO04	Store, pallet, monthly rate
G_STORE	STO05	Retain coarse project
G_STORE	STO06	Retain pulp residue
G_STAMP_DISP		Sample/Waste disposal fee
G_DISP	DIS10	Disposal via pallet, includes transfer of samples
G_DISP	DIS11	Disposal via skip, includes transfer of samples
G_DISP	DIS12	Disposal via steel cage, includes transfer of samples
G_DISP	DIS13	Disposal via bulka bag, includes transfer of samples
G_DISP	DIS14	Disposal of sample material, per kg rate
G_DISP	DIS15	Disposal of samples, incineration (soils)



Sample Preparation

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. 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 technical personnel 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 utilized 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.

Bowl Selection

BOWL TYPE	SAMPLE CAPACITY	MAIN CONTAMINANT	MINOR CONTAMINANT
Standard mild steel bowl	To 3 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 enquire.

Sample Preparation Procedures

SPLITTING

CODE	ANALYTE CODE	DESCRIPTION
G_SPL	SPL_RF	Manual Riffle Splitting
G_SPL	SPL_RF_WT	Manual Riffle Splitting, per kg
G_SPL	SPL_CQ	Cone and Quarter Splitting
G_SPL	SPL_CQ_WT	Cone and Quarter Splitting, per kg
G_SPL	SPL_X	Split additional representative samples
G_SPL	SPL_X_WT	Split additional representative samples, per kg
G_SPL	SPL_RO	Rotary Split <3 kg
G_SPL	SPL_RO_WT	Rotary Split >3 kg, per kg
G_SPL	SPL_RO_M	Rotary Split, Micro Split <100 g

DRYING

CODE	ANALYTE CODE	DESCRIPTION
G_DRY	DRY105	Sample Drying, 105°C, <3 kg
G_DRY_KG	DRY105_WT	Sample Drying, 105°C, >3kg, per kg
G_DRY	MICRO_105	Microwave Sample Drying, 105°C, <3 kg
G_DRY_KG	MICRO_WT	Microwave Sample Drying, 105°C, >3 kg, per kg
G_DRY	DRY60	Sample Drying, 60°C, <3 kg
G_DRY_KG	DRY60_WT	Sample Drying, 60°C, >3kg, per kg
G_DRY	DRY_AIR	Sample Drying, Room Temp, <3 kg
G_DRY_KG	DRYAIR_WT	Sample Drying, Room Temp, >3 kg, per kg
G_DRY_KG	DRY_XT_WT	Sample Drying, Excessively Wet Samples
G_DRY_KG	DRY_C	Oven Drying, 105°C, Carbon Samples
G_DRY_KG	DRY_V	Sample Drying, Variable Temp, per kg



CRUSHING

CODE	ANALYTE CODE	DESCRIPTION
G_CRU	CRU3	Coarse crush 3.36 mm
G_CRU_KG	CRU3_WT	Coarse crush 3.36 mm, per kg
G_CRU	CRU6	Coarse crush 6 mm
G_CRU_KG	CRU6_WT	Coarse crush 6 mm, per kg
G_CRU	CRU75	Crush <3 kg, 75% passing 2 mm
G_CRU_KG	CRU75_WT	Crush >3kg, per kg, 75% passing 2 mm
G_CRU	CRU90	Crush <3 kg, 90% passing 2 mm
G_CRU_KG	CRU90_WT	Crush >3 kg, per kg, 90% passing 2 mm
G_CRU_KG	CRUVM_WT	Crush various mesh sizes, per kg
G_PUL	PUL_CRM	CRM Pulverize <3 kg, 90% passing 1 mm
G_PUL	PUL_CRM_KG	CRM Pulverize >3 kg, per kg, 90% passing 1 mm

SCREENING

CODE	ANALYTE CODE	DESCRIPTION
G_SCR_D	SOIL_WT	Dry Screening to-80mesh (180µm), per kg
G_SCR_D	G_SCR_KG	Dry Screening, various micron particle sizes, per kg
G_SCR_W	G_SCR_KG	Wet Screening, various micron particle sizes, per kg
G_MET	CYC01	Cyclosizing
G_FAS	SCR75	Metallic/Screening Procedure 75 µm
G_FAS	SCR106	Metallic/Screening Procedure 106 µm
G_FAS	SCR212	Metallic/Screening Procedure 212 µm
G_SCR	SCR21	Wet Screening Desliming, various micron particle sizes per kg

PULVERIZING

CODE	ANALYTE CODE	DESCRIPTION
G_PUL	PUL85_CR	Pulv, Cr Steel, 85% 75µm 250g
G_PUL	PUL85_CR500	Pulv, Cr Steel, 85% 75µm 500g
G_PUL	PUL85_CR800	Pulv, Cr Steel, 85% 75µm 800g
G_PUL	PUL85_CR1000	Pulv, Cr Steel, 85% 75µm 1000g
G_PUL	PUL85_CR3000	Pulv, Cr Steel, 85% 75µm 3000g
G_PUL	PUL85_CR_KG	Pulv, Cr Steel, 85% 75µm >3000g
G_PUL	PUL90_CR250	Pulv, Cr Steel, 90% 75µm 250g
G_PUL	PUL90_CR500	Pulv, Cr Steel, 90% 75µm 500g
G_PUL	PUL90_CR800	Pulv, Cr Steel, 90% 75µm 800g
G_PUL	PUL90_CR1000	Pulv, Cr Steel, 90% 75µm 1000g
G_PUL	PUL90_CR3000	Pulv, Cr Steel, 90% 75µm 3000g
G_PUL	PUL90_CR_KG	Pulv, Cr Steel, 90% 75µm >3000g
G_PUL	PUL85_ZR	Pulv, Zirconia bowl, 50-80g
G_PUL	PUL85_W	Pulv, Tungsten Carbide Bowl <100g
G_PUL	PUL85_A	Pulv, Agate/Ceramic Mort & Pest <100g
G_PUL	PUL85_A_RING	Pulv, Agate/Ceramic Ringmill <100g
G_PUL	PUL_X_KG	Pulv, Specified Mesh Size per kg
G_PUL	GRD106_A	Disc Grind, 106µm 500g-1.5kg
G_PUL	GRD106_B	Disc Grind, 106µm 1.5kg-3.5kg
G_PUL	GRD106_WT	Disc Grind, 106µm >3.5kg, per kg
G_PUL	PUL_R	Ringmill Preparation, Carbon Sample(s)
G_PUL	PUL_H	Hand Preparation, Carbon Sample(s)
G_PUL	PUL_CON	Pulverization of Concentrates

Note: Samples can also be pulverized at customer specified grain sizes (i.e. 106 or 120 microns) and % passing requirements. Please enquire.



Miscellaneous Procedures

CODE	ANALYTE CODE	DESCRIPTION
G_WSH	G_WSH_CRU	Barren wash after crushing stage
G_WSH	G_WSH_PUL	Barren wash after pulverizing stage
G_PRP	PRP_COM	Compositing samples
G_PRP	PRP_COM_KG	Compositing samples, per kg
G_RAD		Radiation monitoring using scintillation counter
G_PRP	PRP_EN	Radioactive preparation environment
G_PRP	PRP_EN2	Asbestos preparation environment
G_QRT		Sample quarantine and handling

Moisture and Loss on Ignition (LOI)

Many materials contain volatile components and/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 and quantitative analyses of these parameters.

MOISTURE (H₂O)

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
G_PHY03V	H ₂ O-	≥ 0.1 %	Bulk, Gravimetric determination at 105°C
G_PHY04V	H ₂ O-	≥ 0.01 %	Pulp, Gravimetric determination at 105°C
G_PHY05V	H ₂ O-	≥ 0.1 %	Penfield tube

LOSS ON IGNITION (LOI)

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
G_PHY01V	LOI	-10- 100 %	Gravimetric determination at 1000°C
G_PHY02V	LOI	-50- 100 %	Multi-point TGA determinations

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

Specific Gravity and Bulk Density

Density is a fundamental rock property and can be defined a number of different ways. At SGS, we determine the specific gravity (SG) and bulk density (BD) of rocks, ores and aggregates. Specific gravity is the density of a material relative to water or air and is expressed as a dimensionless number. It is normally measured by the gas pycnometer method on pulp samples and amounts to the average SG of the mineral particles making up the rock or ore. It is an important parameter when developing metallurgical flowsheets or calculating the exact weight of a concentrate being shipped or stored. Density profiles of ores for dense media separation can be measured using heavy liquids.

Bulk density is the average SG of the minerals comprising a rock plus the void space (from vugs, pores, etc.) and is measured by the water immersion method on fist sized rock samples or core. Samples are waxed if there is significant porosity. If the rock samples are competent waxing may not be necessary.

Bulk density along with grade and volume is an extremely important parameter in calculating tonnages for Mineral Resource estimates or ore reserves, which are critical for economic evaluation of mineral deposits. Inadequate BD measurements are often at the root of errors in ore estimates with financial consequences for projects.

Use high quality specific gravity, bulk density and grain size physical property data from SGS for robust Resource Estimate calculations and in developing mineral processing flow sheets.

G_PHY06V	Specific gravity - pycnometer
G_PHY08V	Specific gravity - volumetric
G_PHY17V	Bulk density- immersion, waxed
G_PHY18V	Bulk density - immersion, non-waxed

Particle Size Analysis

Particle size analysis is used to determine the size classification of tills, sediments or ores or to produce sized fractions for additional testing/analysis. 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 separated (i.e. 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 samples.

G_PHY15V	Particle size, sieve analysis (dry or wet)
G_PHY16V	Particle size, laser diffraction



Exploration Grade Analysis

Global service providing a range of geochemical methods for finding and characterizing mineral deposits of every type.

Finding economically viable mineral deposits requires an expert understanding of the geochemical signatures and footprints of potential ore bodies.

We lead the way in providing fit for purpose exploration geochemical analysis solutions that support exploration programs around the world. Utilizing a range of effective and proven methods, including our innovative Mobile Metal Ion (MMI™) technology, we can help you in the discovery of all categories of ore systems, including critical metals, industrial materials, base and precious metal deposits.

Precious Metals 

Multi Element, Trace ICP-OES and ICP-MS Packages 

Exploration Grade XRF Analysis 

Fusion-XRF Packages 

Mobile Metal Ion – MMI™ Soil Geochemistry 

Biogeochemistry 

Lithogeochemistry 

Hydrogeochemistry 

Precious Metals

Precious metals (gold, silver and the platinum group elements) can be analyzed and assayed by many techniques. Coupled with the many sample preparation options to ensure representative samples SGS sets the benchmark for reliable precious metal assays.

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 enquire.

Gold

EXPLORATION GRADE ANALYSIS

FIRE ASSAY GOLD

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GE_FAA30V5	Au	5 - 10,000 ppb	30 g, Fire assay, AAS finish
GE_FAA50V5	Au	5 - 10,000 ppb	50 g, Fire assay, AAS finish
GE_FAI30V5*	Au**	1 - 10,000 ppb	30 g, Fire assay, ICP-OES finish
GE_FAI50V5*	Au**	1 - 10,000 ppb	50 g, Fire assay, ICP-OES finish
GE_FAI31V5	Au**	5 - 10,000 ppb	30 g, Fire assay, ICP-OES finish
GE_FAI51V5	Au**	5 - 10,000 ppb	50 g, Fire assay, ICP-OES finish
GE_FAM30V5	Au**	1 - 2,000 ppb	30 g, Fire assay, ICP-MS finish
GE_FAM50V5	Au**	1 - 2,000 ppb	50 g, Fire assay, ICP-MS finish

Note: *GE_FAI30V5/GE_FAI50V5 methods use new fire assay pots to achieve these lower limits.

** Pt and Pd can be included.

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.



GOLD BY ACID DIGESTION (AQUA REGIA)

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GE_ARE1V50	Au	1 - 800 ppb	50 g, Aqua regia digest, DIBK extraction, AAS finish
GE_ARE2V25	Au	0.01 - 100 ppm	25 g, Aqua regia digest, DIBK extraction, AAS finish
GE_ARE2V50	Au	0.01 - 100 ppm	50 g, Aqua regia digest, DIBK extraction, AAS finish
GE_ARMV25	Au*	1 - 500 ppb	25 g, Aqua regia digest, ICP-MS finish
GE_ARMV50	Au*	1 - 500 ppb	50 g, Aqua regia digest, ICP-MS finish

Note: *Additional elements are available on request

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 analyzed. 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_MBLA65V30	Au	0.03 - 100 ppm	Hot, 30 g, Mini cyanide leach, AAS finish
GE_BLE61K	Au	0.01 - 100 ppm	500 g, Active cyanide leach, Solvent extraction, AAS finish
GE_BLE61NL	Au	1 - 10,000 ppb	2000 g, Active cyanide leach, Solvent extraction, AAS 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. 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_LWE69J	Au	0.01 - 1,000 ppm	200 g, Accelerated cyanide leach, AAS finish
GE_LWE69K	Au	0.01 - 1,000 ppm	500 g, Accelerated cyanide leach, AAS finish
GE_LWE69L	Au	0.01 - 1,000 ppm	800 g, Accelerated cyanide leach, AAS finish
GE_LWE69M	Au	0.01 - 1,000 ppm	1000 g, Accelerated cyanide leach, AAS finish
GE_LWE69N	Au	0.01 - 1,000 ppm	2000 g, Accelerated cyanide leach, AAS finish

Note: These methods are also available with ICP-MS finish

ORE-GRADE ANALYSIS

INSTRUMENTAL AND GRAVIMETRIC ANALYSIS

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GO_FAA30V10	Au	0.01 - 100 ppm	30 g, Fire assay, AAS finish
GO_FAA50V10	Au	0.01 - 100 ppm	50 g, Fire assay, AAS finish
GO_FAP30V10	Au	0.01 - 100 ppm	30 g, Fire assay, MP-AES finish
GO_FAP50V10	Au	0.01 - 100 ppm	50 g, Fire assay, MP-AES finish
GO_FAI30V10	Au **	0.01 - 100 ppm	30 g, Fire assay, ICP-OES finish
GO_FAI50V10	Au **	0.01 - 100 ppm	50 g, Fire assay, ICP-OES finish
GO_FAG30V	Au	0.5 - 10,000 ppm	30 g, Fire assay, gravimetric finish
GO_FAG50V	Au	0.5 - 10,000 ppm	50 g, Fire assay, gravimetric finish
GO_FAG32V	Au	0.01 - 100 ppm	30 g, Fire assay, AAS finish (Au) gravimetric finish (Ag)
	Ag	10 - 10,000 ppm	
GO_FAG52V	Au	0.01 - 100 ppm	50 g, Fire assay, AAS finish (Au) gravimetric finish (Ag)
	Ag	10 - 10,000 ppm	
GO_FAG33V	Au	0.5 - 10,000 ppm	30 g, Fire assay, gravimetric finish (Au, Ag)
	Ag	10 - 10,000 ppm	

** Pt and Pd can be included.

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 weight of the sample to a defined grain size, typically 75, 106 or 200 microns.
- Weighing the various fractions.
- Assaying the entire plus fraction.
- Weighing and analyzing the undersize (typically 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-OES 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), 30 g. Fire assay
	Ag	≥ 10 ppm	AAS/ICP/Gray, 500g
GO_FAS50K	Au	≥ 0.01 ppm	Au, Ag, screen metallics* (75/106/212), 50 g. Fire assay
	Ag	≥ 10 ppm	AAS/ICP/Gray, 500g
GO_FAS30M	Au	≥ 0.01 ppm	Au, Ag, screen metallics* (75/106/212), 30 g. Fire assay
	Ag	≥ 10 ppm	AAS/ICP/Gray, 1000g
GO_FAS50M	Au	≥ 0.01 ppm	Au, Ag, screen metallics* (75/106/212), 50 g. Fire assay
	Ag	≥ 10 ppm	AAS/ICP/Gray, 1000g
GO_FAS30V	Au	≥ 0.01 ppm	Au, Ag, screen metallics* (75/106/212), 30 g. Fire assay
	Ag	≥ 10 ppm	AAS/ICP/Gray, >1000g
GO_FAS50V	Au	≥ 0.01 ppm	Au, Ag, screen metallics* (75/106/212), 50 g. Fire assay
	Ag	≥ 10 ppm	AAS/ICP/Gray, >1000g

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_FAA30V10	Au	0.01 - 1,000 ppm	30 g, Fire assay, AAS finish
GC_FAA50V10	Au	0.01 - 1,000 ppm	50 g, Fire assay, AAS finish
GC_FAG32V	Au	0.01 - 1,000 ppm	30 g, Fire assay, AAS finish (Au)
	Ag	≥ 10 ppm	30 g, Fire assay, gravimetric finish (Ag)
GC_FAG33V	Au	≥ 0.5 ppm	30 g, Fire assay, gravimetric finish (Au)
	Ag	≥ 10 ppm	30 g, Fire assay, gravimetric finish (Ag)

GOLD IN PROCESS SOLUTIONS

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GC_FSA84T	Au	≥ 0.01 mg/L	Solution, Fire assay, AAS finish
GC_FSI84T*	Au	≥ 0.01 mg/L	Solution, Fire assay, ICP-OES finish

Note: These methods are also applicable to cyanide liquors. Pt, Pd can be added. * The Pt and Pd can only be added for GC_FSI84T

GOLD IN CYANIDE LIQUORS

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GC_AAS82T	Au	≥ 0.05 mg/L	CN solution, AAS finish
GC_AAS82X	Au	≥ 0.001 mg/L	Solvent extraction, DIBK, AAS finish

GOLD IN CARBON

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GC_FAA01V100	Au	5 - 20,000 ppm	1 - 2 g, Fire assay, AAS finish
	Ag	≥ 50 ppm	1 - 2 g Fire Assay, gravimetric finish
GC_ACA22D100V	Au	5 - 250,000 ppm	1 g, Ash, acid digest, AAS finish
GC_FAG01V	Au	≥ 7.5 ppm	1 - 2 g, Fire assay, gravimetric finish
	Ag	≥ 50 ppm	1 - 2 g Fire Assay, gravimetric finish

GOLD BULLION

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GC_BUL36V	Au	0.5 - 99.5%	100 - 500 mg, Fire assay, gravimetric finish
	Ag	0.01 - 99.5%	100 - 500 mg, Fire assay, gravimetric finish



Silver

EXPLORATION GRADE ANALYSIS

ACID DIGESTION - INSTRUMENTATION

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GE_AAS22E50	Ag	0.3 - 100 ppm	2 g, 2-Acid digest, AAS finish
GE_AAS33E50	Ag	0.3 - 100 ppm	2 g, 3-Acid digest, AAS finish
GE_AAS42E50	Ag	0.3 - 100 ppm	2 g, 4-Acid digest, AAS finish

Note: It is recommended that mineralized samples with Ag >30 ppm are analyzed using the GO_AAS21C50 method below. Silver (Ag) can also be analyzed in many multi-element packages.

ORE-GRADE ANALYSIS

ACID DIGESTION - INSTRUMENTATION

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

GRAVIMETRIC ANALYSIS

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GO_FAG32V	Au	0.01 - 100 ppm	30 g, Fire assay, AAS finish (Au) gravimetric finish (Ag)
	Ag	10 - 10,000 ppm	
GO_FAG33V	Au	0.5 - 10,000 ppm	30 g, Fire assay, gravimetric finish (Au, Ag)
	Ag	10 - 10,000 ppm	
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_AAS43V100	Ag	1 - 1,000 ppm	Variable wt, 4-acid digest, AAS finish
GC_FAG32V	Au	0.01 - 1,000 ppm	30 g, Fire assay, AAS finish (Au) gravimetric finish (Ag)
	Ag	≥ 10 ppm	
GC_FAG33V	Au	≥ 0.5 ppm	30 g, Fire assay, gravimetric finish (Au, Ag)
	Ag	≥ 10 ppm	
GC_ACA22D100V	Ag	2 - 2,000 ppm	Carbon, 1 g, ash, acid digest, extract, AAS finish
GC_BUL36V	Ag	0.01 - 99.5%	100-500 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_FAI30V5*	Au	1 - 10,000 ppb	30 g, Fire assay, ICP-OES finish
	Pt	10 - 10,000 ppb	
	Pd	1 - 10,000 ppb	
GE_FAI50V5*	Au	1 - 10,000 ppb	50 g, Fire assay, ICP-OES finish
	Pt	10 - 10,000 ppb	
	Pd	1 - 10,000 ppb	
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_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_FAI31V5	Au	5 - 10,000 ppb	30 g, Fire assay, ICP-OES finish
	Pt	10 - 10,000 ppb	
	Pd	5 - 10,000 ppb	
GE_FAI51V5	Au	5 - 10,000 ppb	50 g, Fire assay, ICP-OES finish
	Pt	10 - 10,000 ppb	
	Pd	5 - 10,000 ppb	

Note: *GE_FAI30V5 & GE_FAI50V5 methods use new fire assay pots to achieve lower limits.

ORE-GRADE ANALYSIS GOLD, PLATINUM AND PALLADIUM

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

CONTROL-GRADE ANALYSIS GOLD, PLATINUM AND PALLADIUM

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GC_FAI35V10	Au	0.02 ppm - 20%	Variable wt, Fire assay, ICP-OES finish
	Pt	0.02 ppm - 20%	
	Pd	0.02 ppm - 20%	
GC_FAA35V10	Au	0.02 ppm - 20%	Variable wt, Fire assay, AAS finish
	Pt	0.02 ppm - 20%	
	Pd	0.02 ppm - 20%	

PLATINUM GROUP ELEMENTS

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
GC_FAI41V10	Au	≥ 0.02 ppm	30 g, Fire assay nickel sulphide collection, ICP-OES
	Pt	≥ 0.02 ppm	
	Pd	≥ 0.02 ppm	
	Rh	≥ 0.02 ppm	
	Ru	≥ 0.05 ppm	
	Ir	≥ 0.13 ppm	

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

CODE	ELEMENT	LIMITS	DESCRIPTION
GC_FAM42V10	Pt	0.02 ppm	30 g, Fire assay nickel sulphide collection, ICP-MS
	Pd	0.02 ppm	
	Rh	0.02 ppm	
	Ru	0.05 ppm	
	Ir	0.02 ppm	

Note: This method is not available in all SGS laboratories. Samples can be analyzed for Osmium by neutron activation. Please contact us for more information.



Multi Element, Trace ICP-OES and ICP-MS Packages

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.

Typically, reconnaissance exploration grade samples (including regional soil samples) are analyzed by aqua regia digestion followed by a multielement ICP-OES 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 by 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-OES and ICP-MS are the most widely used geoanalytical instrumentation techniques because they yield many elements concurrently at low detection limits and wide ranges. These instruments are accepted in the mineral exploration industry as rapid and cost-effective means of analysis. Other instruments that can be used for specific elements 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 digestion, the solution is analyzed by either ICP-OES or ICP-MS or both. Digestions can be analyzed by Hydride AAS to determine the hydride forming elements: Sb, As, Bi, Se and Te. Two-acid digests are weak and will not attack silicate minerals. As such, the leach provides partial results for most elements.

The methods listed below with the designation "21B20" 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 "21B20" and "22B20" digests.

NOTE: Requires a minimum sample weight of 0.5g. Lower and upper limits can vary slightly among SGS laboratories because some laboratories may not have access to high purity reagents and consumables. Please speak with your local laboratory manager to ensure you receive the reporting limits you require.

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

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

GE_ICP21B20 or GE_ICP22B20

ELEMENTS AND LIMIT(S)

Ag 2 - 100 ppm*	Hg 1 - 10,000 ppm	Sb 5 - 10,000 ppm
Al 0.005 - 15%	K 0.005 - 15%	Sc 0.5 - 10,000 ppm
As 3 - 10,000 ppm	La 0.5 - 10,000 ppm	Sn 10 - 10,000 ppm
Ba 2 - 10,000 ppm	Li 1 - 10,000 ppm	Sr 0.5 - 10,000 ppm
Be 0.5 - 2,500 ppm	Mg 0.001 - 15%	Ti 0.001 - 15%
Bi 5 - 10,000 ppm	Mn 2 - 10,000 ppm	V 1 - 10,000 ppm
Ca 0.002 - 15%	Mo 1 - 10,000 ppm	W 10 - 10,000 ppm
Cd 1 - 10,000 ppm	Na 0.005 - 15%	Y 0.5 - 10,000 ppm
Co 1 - 10,000 ppm	Ni 1 - 10,000 ppm	Zn 1 - 10,000 ppm
Cr 1 - 10,000 ppm	P 0.003 - 15%	Zr 0.5 - 10,000 ppm
Cu 0.5 - 10,000 ppm	Pb 2 - 10,000 ppm	
Fe 0.01 - 15%	S 0.01 - 5%	

*Note: The upper limit for Ag by GE_ICP22B20 is 10ppm

TWO ACID / AQUA REGIA DIGESTION / ICP-MS PACKAGE (37 ELEMENTS)

GE_IMS21B20 or GE_IMS22B20

ELEMENTS AND LIMIT(S)

Ag 0.01 - 10 ppm	Ga 0.1 - 10,000 ppm	Sb 0.05 - 10,000 ppm
Al 0.01 - 10%	Hg 0.01 - 100 ppm	Sc 0.1 - 10,000 ppm
As 1 - 10,000 ppm	K 0.01 - 10%	Sn 0.2 - 1,000 ppm
Ba 5 - 10,000 ppm	La 0.1 - 10,000 ppm	Sr 0.5 - 10,000 ppm
Be 0.05 - 100 ppm	Mg 0.01 - 15%	Th 0.05 - 10,000 ppm
Bi 0.01 - 10,000 ppm	Mn 2 - 10,000 ppm	Ti 0.01 - 10%
Ca 0.01 - 15%	Mo 0.05 - 10,000 ppm	Tl 0.02 - 10,000 ppm
Cd 0.01 - 10,000 ppm	Na 0.01 - 10%	U 0.05 - 10,000 ppm
Ce 0.02 - 1,000 ppm	Ni 0.2 - 10,000 ppm	V 1 - 10,000 ppm
Co 0.1 - 10,000 ppm	P 0.01 - 1%	W 0.05 - 10,000 ppm
Cr 1 - 10,000 ppm	Pb 0.2 - 10,000 ppm	Y 0.05 - 10,000 ppm
Cu 0.5 - 10,000 ppm	Rb 0.05 - 10,000 ppm	Zn 1 - 10,000 ppm
Fe 0.01 - 15%		

TWO ACID / AQUA REGIA DIGESTION / COMBINED ICP-OES AND ICP-MS PACKAGE (51 ELEMENTS)

GE_ICM21B20 (ICP21B20 & IMS21B20) OR GE_ICM22B20 (ICP22B20 & IMS21B20)

ELEMENTS AND LIMIT(S)

Ag 0.01 - 100* ppm	Hg 0.01 - 100 ppm	Sc 0.1 - 10,000 ppm
Al 0.005 - 15%	In 0.005 - 500 ppm	Se 1 - 1,000 ppm
As 1 - 10,000 ppm	K 0.005 - 15%	Sn 0.2 - 1,000 ppm
Ba 2 - 10,000 ppm	La 0.1 - 10,000 ppm	Sr 0.5 - 10,000 ppm
Be 0.05 - 100 ppm	Li 0.5 - 10,000 ppm	Ta 0.01 - 10,000 ppm
Bi 0.01 - 10,000 ppm	Lu 0.01 - 1,000 ppm	Tb 0.02 - 10,000 ppm
Ca 0.002 - 15%	Mg 0.001 - 15%	Te 0.05 - 1,000 ppm
Cd 0.01 - 10,000 ppm	Mn 2 - 10,000 ppm	Th 0.05 - 10,000 ppm
Ce 0.02 - 1,000 ppm	Mo 0.05 - 10,000 ppm	Ti 0.001 - 15%
Co 0.1 - 10,000 ppm	Na 0.005 - 15%	Tl 0.02 - 10,000 ppm
Cr 1 - 10,000 ppm	Nb 0.05 - 1,000 ppm	U 0.05 - 10,000 ppm
Cs 0.05 - 1,000 ppm	Ni 0.2 - 10,000 ppm	V 1 - 10,000 ppm
Cu 0.5 - 10,000 ppm	P 0.003 - 15%	W 0.05 - 10,000 ppm
Fe 0.01 - 15%	Pb 0.2 - 10,000 ppm	Y 0.05 - 10,000 ppm
Ga 0.1 - 10,000 ppm	Rb 0.05 - 10,000 ppm	Yb 0.1 - 100 ppm
Ge 0.1 - 10,000 ppm	S 0.01 - 5%	Zn 1 - 10,000 ppm
Hf 0.05 - 500 ppm	Sb 0.05 - 10,000 ppm	Zr 0.5 - 10,000 ppm

*Note: The upper limit for Ag by GE_ICM22B20 is 10ppm.

TWO ACID / AQUA REGIA DIGESTION / HYDRIDE AAS PACKAGE

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	



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”. NOTE: Requires a minimum sample weight of 0.5g. Lower and upper limit can vary slightly among SGS laboratories because some laboratories may not have access to high purity reagents and consumables. Please talk with your local laboratory 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, As, Ba, Cr, Hf, Mo, Mn, Nb, Pb, Sb, Se, Sn, Te, Th, Ti, Ta, U, W, Zr and rare earth elements in some sample types.

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

GE_ICP40Q12

ELEMENTS AND LIMIT(S)

Ag 2 - 100 ppm	Fe 0.01 - 15%	S 0.005 - 5%
Al 0.01 - 15%	K 0.01 - 15%	Sb 5 - 10,000 ppm
As 3 - 10,000 ppm	La 0.5 - 10,000 ppm	Sc 0.5 - 10,000 ppm
Ba 1 - 10,000 ppm	Li 1 - 10,000 ppm	Sn 10 - 10,000 ppm
Be 0.5 - 2500 ppm	Mg 0.002 - 15%	Sr 0.5 - 10,000 ppm
Bi 5 - 10,000 ppm	Mn 2 - 10,000 ppm	Ti 0.001 - 15%
Ca 0.005 - 15%	Mo 1 - 10,000 ppm	V 2 - 10,000 ppm
Cd 1 - 10,000 ppm	Na 0.005 - 15%	W 10 - 10,000 ppm
Co 1 - 10,000 ppm	Ni 1 - 10,000 ppm	Y 0.5 - 10,000 ppm
Cr 1 - 10,000 ppm	P 0.001 - 15%	Zn 1 - 10,000 ppm
Cu 0.5 - 10,000 ppm	Pb 2 - 10,000 ppm	Zr 0.5 - 10,000 ppm

Note: Additional elements can be added. Please enquire.

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

GE_ICM40Q12 (GE_ICP40Q12 & GE_IMS40Q12)

ELEMENTS AND LIMIT(S)

Ag 0.02 - 100 ppm	K 0.01 - 15%	Sn 0.2 - 1,000 ppm
Al 0.01 - 15%	La 0.05 - 10,000 ppm	Sr 0.5 - 10,000 ppm
As 1 - 10,000 ppm	Li 0.2 - 10,000 ppm	Ta 0.05 - 10,000 ppm
Ba 1 - 10,000 ppm	Lu 0.01 - 1,000 ppm	Tb 0.05 - 10,000 ppm
Be 0.05 - 2,500 ppm	Mg 0.002 - 15%	Te 0.05 - 1,000 ppm
Bi 0.01 - 10,000 ppm	Mn 2 - 10,000 ppm	Th 0.01 - 10,000 ppm
Ca 0.005 - 15%	Mo 0.05 - 10,000 ppm	Ti 0.001 - 15%
Cd 0.02 - 10,000 ppm	Na 0.005 - 15%	Tl 0.02 - 10,000 ppm
Ce 0.05 - 1,000 ppm	Nb 0.1 - 1,000 ppm	U 0.05 - 10,000 ppm
Cs 0.05 - 1,000 ppm	Ni 1 - 10,000 ppm	V 2 - 10,000 ppm
Co 0.1 - 10,000 ppm	P 0.001 - 15%	W 0.1 - 10,000 ppm
Cr 1 - 10,000 ppm	Pb 0.5 - 10,000 ppm	Y 0.1 - 10,000 ppm
Cu 0.5 - 10,000 ppm	Rb 0.1 - 10,000 ppm	Yb 0.1 - 1,000 ppm
Fe 0.01 - 15%	S 0.01 - 5%	Zn 1 - 10,000 ppm
Ga 0.05 - 500 ppm	Sb 0.005 - 10,000 ppm	Zr 0.5 - 1,000 ppm
Hf 0.02 - 500 ppm	Sc 0.1 - 10,000 ppm	
In 0.005 - 500 ppm	Se 1 - 1,000 ppm	

Note: Select packages for rare earth elements can be found on [page 76](#).



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 analyzes are presumed to provide a complete chemical analysis and are referred to as a “total” analysis.

NOTE: Lower 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 laboratory 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-OES PACKAGE (29 ELEMENTS)

GE_ICP90A50

ELEMENTS AND LIMIT(S)

Al 0.01 - 25%	K 0.1 - 25%	Sc 5 - 50,000 ppm
As 30 - 10,000 ppm	La 10 - 50,000 ppm	Si 0.1 - 30%
Ba 10 - 50,000 ppm	Li 10 - 50,000 ppm	Sn 50 - 50,000 ppm
Be 5 - 25,000 ppm	Mg 0.01 - 25%	Sr 10 - 5,000 ppm
Ca 0.1 - 25%	Mn 10 - 100,000 ppm	Ti 0.01 - 25%
Cd 10 - 50,000 ppm	Mo 10 - 50,000 ppm	V 10 - 50,000 ppm
Co 10 - 50,000 ppm	Ni 10 - 100,000 ppm	W 50 - 40,000 ppm
Cr 20 - 50,000 ppm	P 0.01 - 25%	Y 5 - 25,000 ppm
Cu 10 - 50,000 ppm	Pb 20 - 100,000 ppm	Zn 10 - 50,000 ppm
Fe 0.01 - 25%	Sb 50 - 100,000 ppm	

SODIUM PEROXIDE FUSION / COMBINED ICP-OES AND ICP-MS PACKAGE (54 ELEMENTS)

GE_ICM90A50 (GE_ICP90A50 & GE_IMS90A50)

ELEMENTS AND LIMIT(S)

Ag 5 - 200 ppm	Ge 1 - 1,000 ppm	Sc 5 - 50,000 ppm
Al 0.01 - 25%	Ho 0.05 - 1,000 ppm	Si 0.1 - 30%
As 3 - 10,000 ppm	In 0.2 - 1,000 ppm	Sm 0.1 - 1,000 ppm
Ba 10 - 50,000 ppm	K 0.1 - 25%	Sn 10 - 10,000 ppm
Be 5 - 25,000 ppm	La 0.1 - 10,000 ppm	Sr 10 - 5,000 ppm
Bi 0.1 - 1,000 ppm	Li 10 - 50,000 ppm	Ta 0.5 - 10,000 ppm
Ca 0.1 - 25%	Lu 0.05 - 1,000 ppm	Tb 0.05 - 1,000 ppm
Cd 0.2 - 10,000 ppm	Mg 0.01 - 25%	Th 0.1 - 1,000 ppm
Ce 0.1 - 10,000 ppm	Mn 10 - 100,000	Ti 0.01 - 25%
Co 0.5 - 10,000 ppm	Mo 2 - 10,000 ppm	Tl 0.5 - 1,000 ppm
Cr 20 - 50,000 ppm	Nb 2 - 10,000 ppm	Tm 0.05 - 1,000 ppm
Cs 0.1 - 10,000 ppm	Nd 0.1 - 10,000 ppm	U 2 - 10,000 ppm
Cu 10 - 50,000 ppm	Ni 10 - 100,000 ppm	V 10 - 50,000 ppm
Dy 0.05 - 1,000 ppm	P 0.01 - 25%	W 5 - 10,000 ppm
Er 0.05 - 1,000 ppm	Pb 2 - 50,000 ppm	Y 0.5 - 10,000 ppm
Eu 0.05 - 1,000 ppm	Pr 0.05 - 1,000 ppm	Yb 0.1 - 1,000 ppm
Fe 0.01 - 25%	Rb 2 - 10,000 ppm	Zn 10 - 50,000 ppm
Ga 1 - 1,000 ppm	Sb 1 - 10,000 ppm	
Gd 0.05 - 1,000 ppm		

Note: Ag, Hf & Zr are available under package GE_ICM91A50, please contact our local team for details.



GE_HAS90A20

ELEMENTS AND LIMIT(S)

As 0.5 - 1,000 ppm	Bi 0.5 - 1,000 ppm	Sb 0.5 - 1,000 ppm
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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-OES, ICP-MS or both ICP-OES and ICP-MS. This technique requires a minimum sample weight of 0.2 g.

LITHIUM METABORATE FUSION / ICP-MS PACKAGE (32 ELEMENTS)

GE_IMS95A50

ELEMENTS AND LIMIT(S)

Ce 0.1 - 10,000 ppm	La 0.1 - 10,000 ppm	Ta 0.5 - 10,000 ppm
Co 0.5 - 10,000 ppm	Lu 0.05 - 1,000 ppm	Tb 0.05 - 1,000 ppm
Cs 0.1 - 10,000 ppm	Mo 2 - 10,000 ppm	Th 0.1 - 1,000 ppm
Cu 5 - 10,000 ppm	Nb 1 - 10,000 ppm	Tm 0.05 - 1,000 ppm
Dy 0.05 - 1,000 ppm	Nd 0.1 - 10,000 ppm	U 0.05 - 10,000 ppm
Er 0.05 - 1,000 ppm	Ni 5 - 10,000 ppm	V 5 - 10,000 ppm
Eu 0.05 - 1,000 ppm	Pr 0.05 - 1,000 ppm	W 1 - 10,000 ppm
Ga 1 - 1,000 ppm	Rb 0.2 - 10,000 ppm	Y 0.5 - 1,000 ppm
Gd 0.05 - 1,000 ppm	Sm 0.1 - 1,000 ppm	Yb 0.1 - 1,000 ppm
Hf 1 - 10,000 ppm	Sn 1 - 10,000 ppm	Zr 0.5 - 1,000 ppm
Ho 0.05 - 1,000 ppm		

Note: Lithium metaborate fusion whole rock ICP-OES package GO_ICP95A50 can be found on [page 64](#).

Exploration Grade XRF Analysis

PXRF on exploration grade pulp can be readily added to acid partial digest ICP methods (as above) to include resistive minerals and total recovery of Ti, Zr, Sn, W, Nb, and Ta.

EXPLORATION/SOIL PXRF PACKAGE GE_PXRF73GEO

Pulp based measurement for rocks, sediments, RC drill cuttings and crushed core for litho geochemistry. Sediment samples are used as Quality Control.

ELEMENTS AND LIMIT(S)

Ag* 0.005 - 0.01%	Hg* 0.005 - 0.1%	Sn* 0.01 - 1%
Al 0.2 - 45%	K 0.02 - 5%	Sr 0.0005 - 0.5%
As 0.001 - 2%	La* 0.02 - 0.4%	Ta* 0.005 - 0.1%
Ba 0.05 - 0.4%	Mg* 2.5 - 45%	Th 0.002 - 0.1%
Bi* 0.005 - 0.1%	Mn 0.06 - 3.2%	Ti 0.02 - 2.5%
Ca 0.05 - 32%	Mo 0.005 - 0.05%	Ti* 0.002 - 0.02%
Cd 0.005 - 0.5%	Nb* 0.005 - 1%	U* 0.002 - 0.1%
Ce* 0.02 - 1%	Ni 0.005 - 1%	V* 0.01 - 0.2%
Cl* 0.03 - 2%	P 0.05 - 14.5%	W* 0.005 - 0.1%
Co* 0.005 - 0.3%	Pb 0.001 - 2%	Y 0.0005 - 0.2%
Cr* 0.01 - 1.5%	Rb 0.0005 - 0.05%	Zn 0.002 - 0.8%
Cu 0.0015 - 3%	S 0.02 - 15%	Zr 0.0005 - 1%
Fe 0.01 - 28%	Sb 0.01 - 1%	
Ga* 0.005 - 0.5%	Se* 0.002 - 0.01%	
Hf* 0.005 - 1%	Si 0.5 - 47%	

*Optional elements may be available at select locations with an additional Quality Control setup cost, otherwise indicative assay only. Please enquire.

GE_PXRF73SOIL

Soil, sediments and till samples that are dried, delumped and screened at 180 micron. Till and Sediments are used for Quality Control.

ELEMENTS AND LIMIT(S)

Ag* 0.005 - 0.01%	Hf* 0.005 - 1%	Se* 0.002 - 0.01%
Al 0.2 - 45%	Hg* 0.005 - 0.1%	Si** 0.5 - 47%
As 0.001 - 2%	K 0.02 - 5%	Sn* 0.01 - 1%
Ba 0.05 - 0.4%	La* 0.02 - 0.4%	Sr 0.0005 - 0.5%
Bi* 0.005-0.1%	Mg* 2.5 - 45%	Ta* 0.005 - 0.1%
Ca 0.05 - 32%	Mn 0.06 - 3.2%	Th* 0.002 - 0.1%
Cd 0.005 - 0.5%	Mo 0.005 - 0.05%	Ti 0.02 - 2.5%
Ce* 0.02 - 1%	Nb* 0.005 - 1%	Ti* 0.002 - 0.02%
Cl* 0.03 - 2%	Ni 0.005 - 1%	U* 0.002 - 0.1%
Co* 0.005 - 0.3%	P 0.05 - 14.5%	V 0.01 - 0.2%
Cr* 0.01 - 1.5%	Pb 0.001 - 2%	W* 0.005 - 0.1%
Cu 0.0015 - 3%	Rb 0.0005 - 0.05%	Y 0.0005 - 0.2%
Fe 0.01 - 28%	S 0.02 - 15%	Zn 0.002 - 0.8%
Ga* 0.005 - 0.5%	Sb 0.01 - 1%	Zr** 0.001 - 1%

* Optional elements may be available at select locations with an additional Quality Control setup cost, otherwise indicative assay only. Please enquire.

** Problematic element due to interference / inhomogeneity in soil fraction analyzed.

GE_PXRF73CONC MINING MATERIALS CONCENTRATES/PRODUCT

Pulp measured through a paper or plastic bag or as powder mount. Indicative results reported and adjusted for attenuation of the bag when used. Elements common with bag material (i.e., Ca, Ti and Zn) are not reportable. Matrix matched Quality Control Sample. Ranges contingent on QC samples. Charged on per element basis.

ELEMENTS AND LIMIT(S)

As* 0.005 - 10%	Fe 0.5 - 77%	Sn* 0.1 - 89%
Ba* 0.1 - 10%	Mn 0.5 - 80%	Ta* 0.1 - 82%
Bi* 0.01 - 90%	Ni 0.2 - 80%	W* 0.1 - 80%
Ca 0.5 - 35%	Pb 0.1 - 94%	Zn* 0.1 - 85%
Cr* 0.5 - 69%	S* 0.5 - 30%	Zr* 0.1 - 74%
Cu 0.1 - 85%	Sb* 0.1 - 56%	

* Optional elements may be available at select locations with an additional Quality Control setup cost, otherwise indicative assay only. Please enquire.

GE_PXRF73MIN

Pulp based measurement for mineralized rocks, sediments, RC drill cuttings, crushed core, feeds and concentrates in a loose powder setup.

ELEMENTS AND LIMIT(S)

Ag 0.001 - 0.6% Indic.***	Hf 0.001 - 72% Indic.***	Si 0.1 - 47% X
Al 0.1 - 35% X	Hg 0.002 - 86% Indic.***	Sn 0.005 - 88% Indic.***
As 0.0005 - 50% X	K 0.009 - 10% X	Sr 0.0005 - 1% X
Ba 0.003 - 10% X	La 0.004 - 0.7% Indic.***	Ta 0.003 - 82% Indic.***
Bi 0.0005 - 90% Indic.***	Mg 0.3 - 35% Indic.	Te 0.001 - 0.02% Indic.***
Ca 0.004 - 31% X	Mn 0.002 - 45% X	Th 0.001 - 0.5% Indic.***
Cd 0.001 - 0.7% Indic.***	Mo 0.001 - 67% Indic.***	Ti 0.004 - 60% X
Ce 0.0015 - 4.5% Indic.***	Nb 0.001 - 42% Indic.***	Ti 0.0005 - 0.02% Indic.***
Cl 0.01 - 4% Indic.*	Ni 0.001 - 80. % X	U 0.001 - 0.1% Indic.***
Co 0.001 - 72% Indic.**	P 0.01 - 13. % X	V 0.004 - 56% X
Cr 0.003 - 28% X	Pb 0.0005 - 93% X	W 0.001 - 80% Indic.***
Cs 0.003 - 18% Indic.***	Rb 0.0005 - 0.07% X	Y 0.0005 - 0.2% X
Cu 0.0005 - 80% X	S 0.01 - 41. % X	Zn 0.0005 - 80% X
Fe 0.003 - 70% X	Sb 0.005 - 19% Indic.***	Zr 0.0005 - 39% X
Ga 0.0005 - 0.05% Indic.***	Se 0.0005 - 0.05% Indic.***	

X Quality Controlled data with generic sediment/regolith based reference material

Indic. - Indicative value is reported

Indic.* indicative value with X-Ray tube line overlap

Indic.** indicative value heavy Fe overlap with higher Limit of Detection

Indic.*** Optional elements as indicative values only may be available at select locations with an additional Quality Control setup cost. Please enquire.

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



Fusion-XRF Packages

BORATE FUSION / WD XRF WHOLE ROCK PACKAGE

GO_XRF72

Analyte	Reported as	Package Majors	Package-P	Package Maj/Min	Range
Al	Al ₂ O ₃	X	X	X	0.01 - 100%
As	As ₂ O ₃		X	Extension/Optional Oxide	0.01 - 5%
Ba	BaO	X	X	X	0.01 - 70%
Bi	Bi ₂ O ₃			Extension/Optional Oxide	0.01 - 5%
Ca	CaO	X	X	X	0.01 - 60%
Cl	Cl		X	X	0.01 - 30%
Co	Co ₃ O ₄		X	X	0.01 - 5%
Cr	Cr ₂ O ₃		X	X	0.01 - 5%
Cu	CuO		X	X	0.01 - 5%
F	F			Extension/Optional element	0.5 - 50%
Fe	Fe ₂ O ₃	X	X	X	0.01 - 100%
Hf	HfO ₂			Extension/Optional Oxide	0.01 - 5%
K	K ₂ O	X	X	X	0.01 - 70%
Mg	MgO	X	X	X	0.01 - 100%
Mn	Mn ₃ O ₄	X	X	X	0.01 - 100%
Mo	MoO ₃			Extension/Optional Oxide	0.01 - 5%
Na	Na ₂ O	X	X	X	0.01 - 60%
Ni	NiO		X	X	0.01 - 5%
P	P ₂ O ₅	X	X	X	0.01 - 55%
Pb	PbO		X	Extension/Optional Oxide	0.01 - 5%
Rb	Rb ₂ O			Extension/Optional Oxide	0.01 - 5%
Sb	Sb ₂ O ₃			Extension/Optional Oxide	0.01 - 5%
Si	SiO ₂	X	X	X	0.01 - 100%

Analyte	Reported as	Package Majors	Package-P	Package Maj/Min	Range
Sn	SnO ₂		X	Extension/Optional Oxide	0.01 - 5%
S	SO ₃	X	X	X	0.01 - 10%
Sr	SrO		X	X	0.01 - 5%
Ta	Ta ₂ O ₅			Extension/Optional Oxide	0.01 - 5%
Th	ThO ₂			Extension/Optional Oxide	0.01 - 1%
Ti	TiO ₂	X	X	X	0.01 - 100%
U	U ₃ O ₈			Extension/Optional Oxide	0.01 - 5%
V	V ₂ O ₅	X	X	X	0.01 - 10%
W	WO ₃			Extension/Optional Oxide	0.01 - 5%
Zn	ZnO		X	X	0.01 - 5%
Zr	ZrO ₂		X	X	0.01 - 5%
LOI (1000°C)*		X	X	X	-10 - 100%
Moisture (as received)		Optional	Optional	Optional	≥ 0.01%

*G_PHY01V or G_PHY02V

Unmineralized whole rock analysis; for commodities and specific matrices refer to commodity section. Specialized whole rock XRF packages are available for mineral sands exploration programs

For Ferrous iron (FeO) see [page 60](#).

XRF PACKAGE (26 ELEMENTS) UNIVERSAL SCREENING METHOD BY WD /ED XRF

GE_XRF71SQ

Ag 0.01 - 93%	I 0.005 - 50%	Si 0.05 - 47%
Al 0.05 - 53%	K 0.01 - 83%	Sn 0.01 - 79%
As 0.01 - 76%	La 0.01 - 85%	S 0.004 - 20%
Ba 0.01 - 62%	LOI*	Sr 0.01 - 85%
Bi 0.01 - 45%	Mg 0.06 - 60%	Ta 0.01 - 82%
Br 0.01 - 50%	Mn 0.01 - 72%	Te 0.01 - 40%
Ca 0.01 - 71%	Mo 0.01 - 67%	Th 0.01 - 5%
Ce 0.01 - 60%	Na 0.07 - 74%	U 0.01 - 5%
Cl 0.01 - 55%	Nb 0.01 - 70%	V 0.01 - 56%
Co 0.01 - 73%	Nd 0.01 - 86%	W 0.01 - 79%
Cr 0.01 - 68%	Ni 0.01 - 79%	Y 0.01 - 79%
Cu 0.01 - 80%	P 0.004 - 44%	Zn 0.01 - 80%
Fe 0.01 - 70%	Pb 0.01 - 93%	Zr 0.01 - 74%
Ga 0.01 - 4%	Rb 0.01 - 91%	
Ge 0.01 - 3%	Sb 0.01 - 84%	
Hf 0.01 - 85%	Se 0.01 - 36%	

*G_PHY01V or G_PHY02V



Mobile Metal ION – MMI™ Soil Geochemistry

SGS is the owner and sole provider of MMI™ Technology. We have over 20 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 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-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 metal ions. Thus, 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 or cell-based ICP-MS.

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

- 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 g sample and the extracted solution is analyzed via ICP-MS, providing determinations in the part per billion range. For detailed instructions of the MMI™ sampling protocols and orientation surveys, please visit [sgs.com/geochemistry](https://www.sgs.com/geochemistry) or contact us at naturalresources@sgs.com.

ICP-MS Universal Cell Technology

SGS is committed to the MMI™ Technology. With the development of the ICP-MS combined with reaction cell technology we are able to further enhance this analytical approach. The lower detection limits provided by the removal of interferences using cell based technology inside the ICP-MS means 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 using the MMI-ME package.

Note: S, B, Br, I and Pb isotopes can be added by request

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

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	

GE_MMI-MP

ELEMENTS AND LIMIT(S)

Ag ≥ 0.1ppb	Au ≥ 0.05ppb	Pd ≥ 0.1ppb	Pt ≥ 0.02ppb
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MOBILE METAL ION ENHANCED PACKAGE / ICP-MS (55 ELEMENTS)

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	



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-OES (GE_ICP23D50) and ICP-MS (GE_IMS2350).

GE_ICP23D50

ELEMENTS AND LIMITS

Al 12 - 150,000 ppm	K 7 - 250,000ppm	Sr 0.5 - 10,000 ppm
B 10 - 10,000 ppm	Li 0.2 - 50,000 ppm	Ti 1 - 150,000 ppm
Ba 1 - 10,000 ppm	Mg 9 - 150,000 ppm	S 42 - 410,000 ppm
Ca 30 - 150,000 ppm	Mn 2 - 10,000 ppm	V 20 - 10,000 ppm
Cr 10 - 10,000 ppm	Na 12 - 150,000 ppm	Zn 1 - 10,000 ppm
Cu 0.5 - 10,000 ppm	Ni 1 - 10,000 ppm	Zr 0.05 - 10,000 ppm
Fe 7 - 150,000 ppm	P 18 - 250,000 ppm	

Note: Vegetation sample preparation: Dry and macerate sample (G_DRY_KG, VEG10_WT)) or ash at 475oC (G_PRP, PRP_ASH).

GE_IMS23D50

ELEMENTS AND LIMITS

Ag 0.01 - 10 ppm	Ga 1 - 10,000 ppm	Pb 0.5 - 10,000 ppm	Ta 0.2 - 10,000 ppm
As 10 - 10,000 ppm	Gd 0.01 - 1,000 ppm	Pd 0.01 - 500 ppm	Tb 0.002 - 10,000 ppm
Au 0.005 - 5 ppm	Hf 0.5 - 500 ppm	Pr 0.005 - 1,000 ppm	Te 0.1 - 1,000 ppm
Bi 0.005 - 10,000 ppm	Hg 0.02 - 10,000 ppm	Pt 0.005 - 350 ppm	Th 0.002 - 10,000 ppm
Cd 0.03 - 10,000 ppm	Ho 0.002 - 500 ppm	Rb 0.2 - 10,000 ppm	Tl 0.002 - 1,000 ppm
Ce 0.01 - 1,000 ppm	In 0.005 - 500 ppm	Rh 0.001 - 500 ppm	Tm 0.002 - 1,000 ppm
Co 0.01 - 10,000 ppm	Ir 0.002 - 500 ppm	Sb 0.04 - 10,000 ppm	U 0.001 - 10,000 ppm
Cs 0.005 - 1,000 ppm	La 0.01 - 10,000 ppm	Sc 0.3 - 10,000 ppm	W 0.01 - 10,000 ppm
Dy 0.005 - 1,000 ppm	Lu 0.002 - 10,000 ppm	Se 5 - 1,000 ppm	Y 0.01 - 10,000 ppm
Er 0.005 - 1,000 ppm	Mo 0.05 - 10,000 ppm	Sm 0.005 - 1,000 ppm	Yb 0.002 - 100 ppm
Eu 0.002 - 1,000 ppm	Nd 0.02 - 10,000 ppm	Sn 0.4 - 1,000 ppm	

Note: Vegetation sample preparation: Dry and macerate sample (G_DRY_KG, VEG10_WT)) or ash at 475oC (G_PRP, PRP_ASH).

Lithogeochemistry

Lithogeochemical analysis is used for basic rock characterisation based on major, minor and trace element chemistry. It requires whole rock analytical methods to ensure that refractory minerals such as zircon and chromite are fully dissolved.

Lithogeochemical analysis may be used in exploration programs for identification of different rock types that might occur in drill core or at outcrop, particularly when primary lithologies are obscured by subsequent alteration or metamorphic events.

Lithogeochemical analysis is also used by geological surveys undertaking geological mapping projects, by researchers studying geological, geochemical and petrological processes and by oil companies requiring complete rock characterization for calibrating core responses to borehole sensors.

Recommended whole rock analytical packages for lithogeochemistry or complete rock characterization:

Major elements: Borate fusion XRF package 12 elements & LOI. Not for mineralized samples for which the lithium metaborate fusion/ICP-AES whole rock package GO_ICP95A50 is recommended. Ferrous iron is determined by a titration method GC_CLA01V

Trace elements: The sodium peroxide fusion, ICP-AES / ICP-MS combined 56 element package GE_ICM91A50 is recommended as it includes Zr and Hf as key trace elements.

Other elements: C, S, F, Cl are listed in the section on Individual Methods. Water of hydration or H₂O⁺ is determined by the Penfield tube method G_PHY05V.



Hydrogeochemistry

The analyzes 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 limits can increase. Requests for environmental services will be forwarded to an SGS Environmental Services Laboratory.

GROUND WATER ANALYSIS / ICP-OES PACKAGE

GE_ICP80T

ELEMENTS AND LIMIT(S)

Ag ≥ 0.001 ppm	Co ≥ 0.01 ppm	Mn ≥ 0.005 ppm	Sn ≥ 0.05 ppm
Al ≥ 0.05 ppm	Cr ≥ 0.01 ppm	Mo ≥ 0.01 ppm	Sr ≥ 0.001 ppm
As ≥ 0.03 ppm	Cu ≥ 0.005 ppm	Na ≥ 0.05 ppm	Ti ≥ 0.01 ppm
Ba ≥ 0.01 ppm	Fe ≥ 0.05 ppm	Ni ≥ 0.01 ppm	V ≥ 0.01 ppm
Be ≥ 0.005 ppm	K ≥ 0.1 ppm	P ≥ 0.05 ppm	W ≥ 0.05 ppm
Bi ≥ 0.05 ppm	La ≥ 0.01 ppm	Pb ≥ 0.03 ppm	Y ≥ 0.005 ppm
Ca ≥ 0.05 ppm	Li ≥ 0.01 ppm	Sb ≥ 0.05 ppm	Zn ≥ 0.005 ppm
Cd ≥ 0.01 ppm	Mg ≥ 0.05 ppm	Sc ≥ 0.001 ppm	Zr ≥ 0.01 ppm

Note: B, S and Si can be added upon request.

GROUND WATER ANALYSIS / ICP-MS PACKAGE

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
Co ≥ 0.1 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
Cs ≥ 0.01 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 and Ir can be added upon request.

ADDITIONAL GROUND WATER ANALYSIS

CODE(S)	ELEMENT	DESCRIPTION
G_PHY14V	Total dissolved solids (TDS)	Gravimetric
GC_ISE10T	pH	Ion selective electrode (ISE)
GE_ISE21T	Fluoride F ⁻	Ion selective electrode (ISE)
GE_ISE30T	Chloride Cl ⁻	Ion selective electrode (ISE)



FOCUS ON ↓

Individual Methods for Exploration Grade Analysis

SULPHUR AND CARBON

CODE(S)	ELEMENT	LIMIT(S)	DESCRIPTION	MIN. SAMPLE WT.(g)
GE_CSA06V	S	0.005 - 30%	IR combustion	0.1 - 0.3
	C	0.005 - 30%		0.1 - 0.3
GE_CSA07D	SO ₄ ²⁻	0.01 - 30%	Leach/ICP-OES	1.0
GE_CSA08Q	S ²⁻	≥ 0.01%	Leach/ IR combustion	0.2
GE_CSA02Q	C (Carbonate)	≥ 0.01%	Leach/IR combustion	0.2
GE_CSB02V	CO ₂ (Carbonate)	≥ 0.05%	Coulometry	0.02 - 0.1
GE_CSA03B	C (organic)	0.01 - 40%	Leach/IR combustion	0.25
	C (inorganic)	0.01 - 30%		
GE_CSB03V	C (organic)	≥ 0.01%	Coulometry	0.02 - 0.1
	C (inorganic)	≥ 0.05%		
GE_CSA05V	C (graphitic)	≥ 0.05%	Leach/IR combustion	0.05
GE_CSB05V	C (graphitic)	≥ 0.05%	Coulometry	0.1

ADDITIONAL SINGLE ELEMENTS

CODE(S)	ELEMENT	LIMIT(S)	DESCRIPTION	MIN. SAMPLE WT.(g)
GE_CVA37A25	Hg	0.005 - 100 ppm	Cold vapour AAS	0.15
GE_ISE20V	F	25 - 100,000 ppm	Ion selective electrode	0.1
GE_ISE30V	Cl	50 - 5,000 ppm	Ion selective electrode	0.2
GE_CLA01V	FeO	0.01 - 10%	Ferrous iron by titration	

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

A wide range of independent quality and quantification services for a variety of metals and minerals

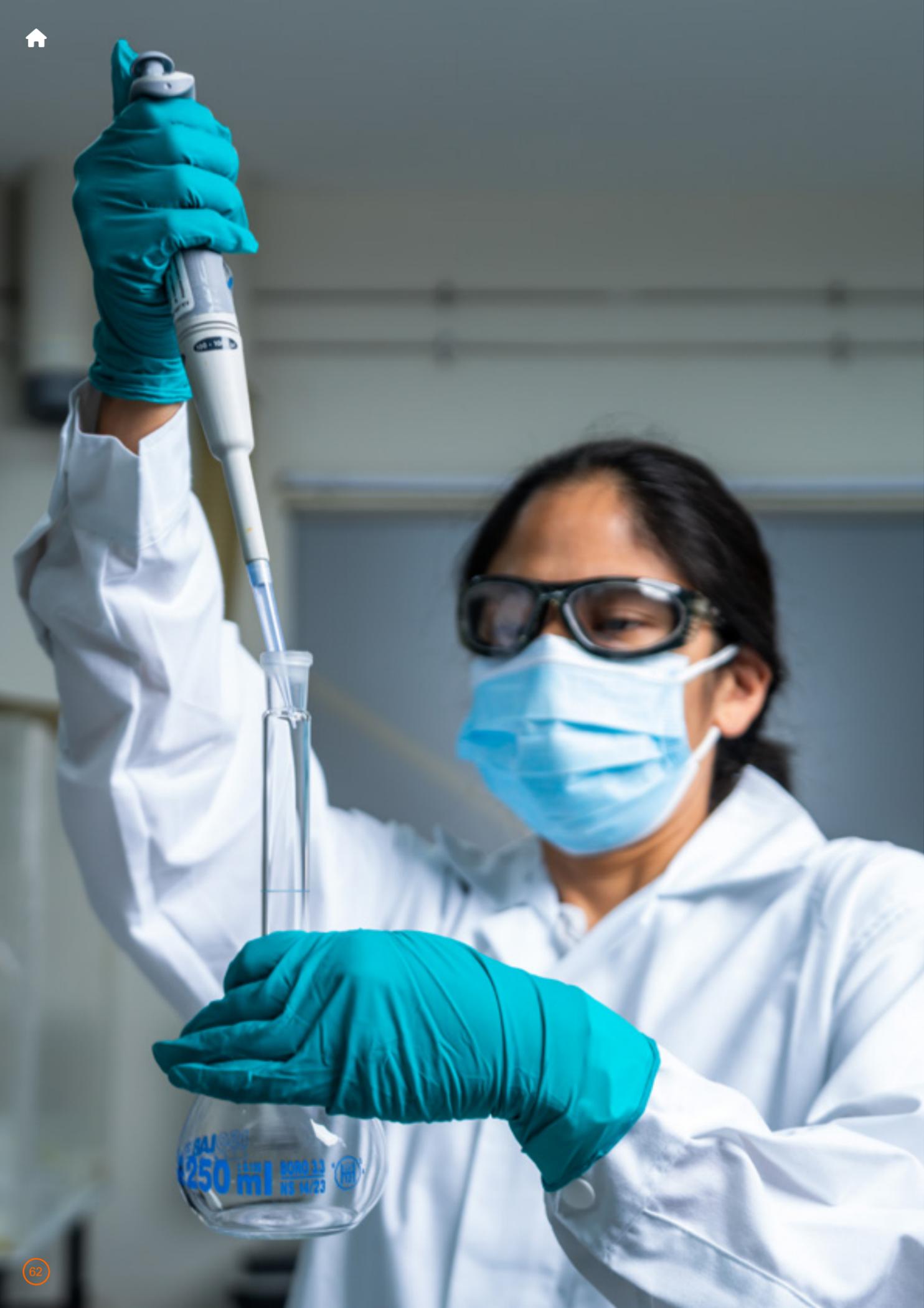
You operate globally, optimizing production and operations from all around the world. Our global network of experts will be your trusted partner, meeting your analytical requirements.

Through our global network of laboratories, our experts offer a variety of instrumental and classical techniques to ensure accurate assays. We will help you select a method that is best for your sample type to ensure you get the data you need.

Our experts are experienced in:

- Precious and base metals
- Critical and battery metals
- Industrial minerals
- Bulk commodities

Whatever the commodity, wherever the location, our trusted professionals will be with you every step of the way.



Ore-grade Analysis

Over Range Methods

AQUA REGIA DIGESTION / ICP-OES

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-OES

GO_ICP42Q100

ELEMENTS AND LIMIT(S)

Ag 0.01 - 0.1%	Cu 0.01 - 30%	Ni 0.001 - 10%
Al 0.1 - 30%	Fe 0.1 - 30%	Pb 0.01 - 30%
As 0.01 - 10%	Li 0.01 - 10%	S 0.01 - 10%
Ca 0.1 - 30%	Mg 0.1 - 30%	Zn 0.01 - 30%
Cd 0.001 - 10%	Mn 0.001 - 10%	
Co 0.001 - 10%	Mo 0.001 - 10%	

Note: Additional elements can be added upon request.

SODIUM PEROXIDE FUSION / ICP-OES

GO_ICP90Q100

ELEMENTS AND LIMIT(S)

As 0.01 - 20%	Mg 0.01 - 30%	Sb 0.01 - 20%
Bi 0.01 - 10%	Mn 0.01 - 30%	Zn 0.01 - 30%
Co 0.01 - 30%	Mo 0.01 - 30%	
Cu 0.01 - 30%	Ni 0.01 - 30%	
Fe 0.05 - 50%	Pb 0.01 - 30%	

Requires a minimum sample weight of 0.2 g. For samples containing these elements at greater than the upper limit an alternative technique will be used for full recovery.



Fusion-ICP Packages

LITHIUM METABORATE FUSION / ICP-OES (LITHOLOGIC) PACKAGE (13 ELEMENTS)

GO_ICP95A50

ELEMENTS AND LIMIT(S)

Al ₂ O ₃ 0.01 - 75%	MnO 0.01 - 10%	*LOI -10 - 100%
CaO 0.01 - 60%	Na ₂ O 0.01 - 30%	
Cr ₂ O ₃ 0.01 - 10%	P ₂ O ₅ 0.01 - 25%	
Fe ₂ O ₃ 0.01 - 75%	SiO ₂ 0.01 - 90%	
K ₂ O 0.01 - 25%	TiO ₂ 0.01 - 25%	
MgO 0.01 - 30%	V ₂ O ₅ 0.01 - 10%	

Note: This is the recommend package for whole rock analysis of sulphide rich, mineralized samples. Requires a minimum sample weight of 0.1g. Note: Ba, Nb, Sr, Y, Zn and Zr can be added upon request. *G_PHY01V or G_PHY02V

SULPHUR AND CARBON

CODE	ELEMENT	LIMIT(S)	DESCRIPTION
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 enquire.

ADDITIONAL SINGLE ELEMENTS

CODE(S)	ELEMENT	LIMIT(S)	DESCRIPTION	MIN. SAMPLEWT.(g)
GO_CVA38B50	Hg	≥ 0.3 ppm	Cold vapour AAS	0.25
GO_CLA30V	Cl	25 - 20,000 ppm	Titration	10

SGS can analyze a number of individual ore-grade elements. Please enquire.

Fusion-XRF Packages

Fusion-XRF packages are available on [page 54](#).



FOCUS ON ↓

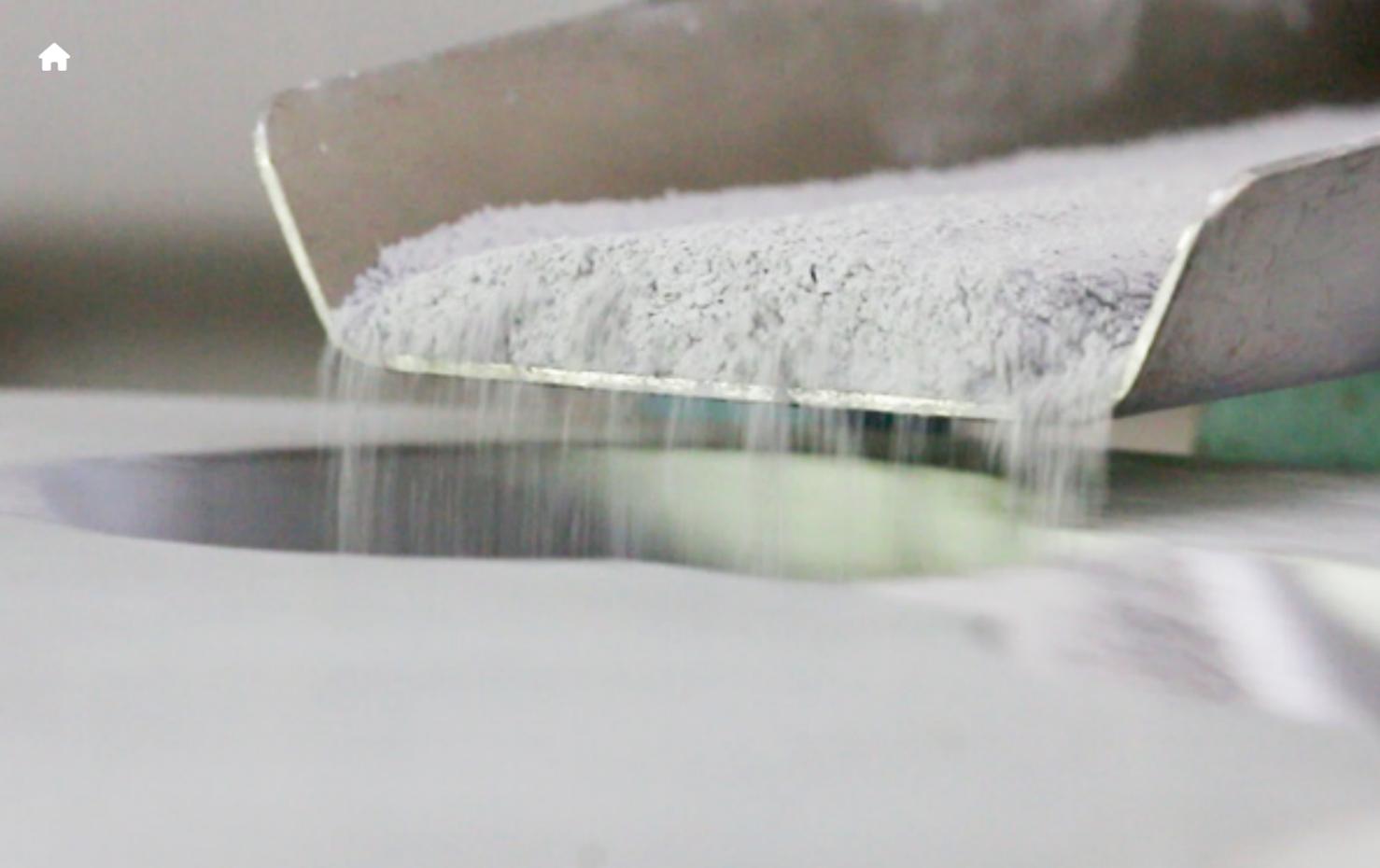
Operational Sustainability

Companies must consider the social and environmental impact of their products across the entire value chain and product lifecycle. This has come to the fore in recent years due to societal shifts, market expectations and increasing regulatory pressures.

Sustainable operations start with producing, repurposing, recycling, and disposing commodities in a safe, healthy, environmentally and socially responsible manner. We deliver a range of robust and practical solutions that help growers, producers, traders, original equipment manufacturers and consumers of raw materials embed sustainability considerations into your operations, product design, procurement and marketing efforts.

Our services, powered by the latest digital technologies and overseen by experts, help clients devise more sustainable operations.

More generally, our services will allow you to effectively tell your story, demonstrate your continued commitment towards sustainability and highlight your Environmental, Sustainability, and Governance (ESG) practices to stakeholders and consumers alike. We can help with data acquisition and validation to demonstrate decarbonization, as well as providing crucial support to you when communicating your ESG metrics to stakeholders.



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 enquire.

- [Bauxite](#)
- [Chromite Ore](#)
- [Copper](#)
- [Fluorspar](#)
- [Generic / Multi-element Ores](#)
- [Graphitic Carbon](#)
- [Iron Ore](#)
- [Limestone / Lime / Industrial Minerals / Cement / Clinker / Dolomite](#)
- [Lithium](#)
- [Manganese Ore](#)
- [Nickel](#)
- [Nickel Laterite](#)
- [Rare Earth Element Analysis](#)
- [Resistive Minerals / Tungsten Tin Ores / Concentrates](#)
- [Uranium](#)

Bauxite

XRF is the industry standard for bauxite analysis.

GO/GT_XRF72BX

ANALYTE	REPORTED AS	RANGE
Al	Al ₂ O ₃	0.01 - 100%
Ba	BaO	0.01 - 5%
Ca	CaO	0.01 - 5%
Cr	Cr ₂ O ₃	0.01 - 1%
Fe	Fe ₂ O ₃	0.01 - 50%
K	K ₂ O	0.001 - 5%
Mg	MgO	0.01 - 10%
Mn	Mn ₃ O ₄	0.01 - 10%
Na	Na ₂ O	0.01 - 10%
P	P ₂ O ₅	0.01 - 10%
Si	SiO ₂	0.05 - 100%
S	SO ₃	0.01 - 1%
Ti	TiO ₂	0.01 - 5%
V	V ₂ O ₅	0.01 - 1%
Zr	ZrO ₂	0.01 - 1%
Ga	Ga ₂ O ₃ option	0.01 - 1%
LOI (1000°C)*	LOI	-10 - 100%

*G_PHY01V or G_PHY02V

Dried sample only.

Additional characterizations available include:

Reactive Silica and Available Alumina, 0.01-100%. With standard digestion temperature 145°C and standard digestion temperature 235°C respectively .

Standard Bomb digest followed by ICP-OES analysis (GO_ICP10V500)

Total Organic Carbon (non Carbonate) TOC using combustion.

Total Carbon by combustion TC using IR combustion.

FTIR based characterization GE_FTIR73BX (below) which includes the typical Bauxite minerals as well as phases correlated to chemistry.

GE_FTIR73BX

Total Alumina 40.0- 55.0%	Total Titanium Oxides 1.0- 3.5%
Available Alumina 5.0- 60.0%	Quartz 1.0- 100.0%
Total Silica 1.0- 60.0%	Goethite 1.0- 20.0%
Reactive Silica 1.0- 29.0%	Kaolinite 1.0- 100.0%
Total Iron Oxides 1.0- 29.0%	

Obtain quantitative infra-red spectral data using an ATR based system including total oxide weight % calibrated against borate fusion XRF and reactive silica and aluminium calibrated against classical bomb digest. Additional compounds available upon request at extra cost.



Chromite Ore

XRF method for analysis of chromite ores in a high dilution borate fusion setup.

GO_XRF72CR

Minimum sample 1g.

ANALYTE	REPORTED AS	RANGE
Al	Al ₂ O ₃	0.02 - 100%
As	As ₂ O ₃ optional	0.02 - 1%
Ba	BaO	0.02 - 20%
Ca	CaO	0.02 - 40%
Co	Co ₃ O ₄ optional	0.02 - 5%
Cr	Cr ₂ O ₃	0.02 - 60%
Cu	CuO optional	0.02 - 5%
Fe	Fe ₂ O ₃	0.02 - 100%
K	K ₂ O	0.02 - 10%
Mg	MgO	0.02 - 50%
Mn	MnO	0.02 - 50%
Na	Na ₂ O	0.05 - 10%
Ni	NiO optional	0.02 - 10%
P	P ₂ O ₅	0.02 - 10%
Pb	PbO optional	0.02 - 5%
Si	SiO ₂	0.05 - 100%
S	SO ₃	0.02 - 1%
Ti	TiO ₂	0.02 - 50%
V	V ₂ O ₅	0.02 - 1.8%
Zn	ZnO optional	0.02 - 5%
LOI (1000°C)*	LOI	-10 - 100%

Dried only

*G_PHY01V or G_PHY02V

Note: Additional grinding might be needed

Copper

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.

EXPLORATION GRADE COPPER METHODS

CODE(S)	LIMIT(S)	DESCRIPTION
GE_ICP22B20 / GE_ICP21B20	0.5 ppm - 1%	2-Acid digest / Aqua regia – ICP-OES
GE_IMS21B20 / GE_IMS22B20	0.5 ppm - 1%	2-Acid digest / Aqua regia – ICP-MS
GE_ICP40Q12	0.5 ppm - 1%	4-Acid digest – ICP-OES
GE_ICP90A50	10 ppm - 5%	Fusion – ICP-OES

ORE-GRADE COPPER METHODS

CODE(S)	LIMIT(S)	DESCRIPTION
GO_ICP21B100	0.01 - 30%	Aqua regia digest – ICP-OES
GO_ICP42Q100	0.01 - 30%	4-Acid digest – ICP-OES
GO_ICP90Q100	0.01 - 30%	Fusion – ICP-OES

CONCENTRATE-GRADE COPPER METHODS

CODE(S)	LIMIT(S)	DESCRIPTION
GC_CON13V	15 - 60%	Short iodide titration
GC_CON03V*	5 - 95%	Electrogravimetry

* These methods can be done at party or umpire quality.

MINERAL SELECTIVE COPPER METHODS

CODE(S)	LIMIT(S)	DESCRIPTION
GC_AAS70D200	≥ 0.002%	Cu oxide method, citric acid leach, AAS
GC_AAS71C50	≥ 0.001%	Cu H ₂ SO ₄ soluble, AAS
GC_AAS74C50	≥ 0.001%	Cu acetic acid soluble, AAS
GC_AAS75D100	≥ 0.001%	CN soluble Cu, AAS
GC_AAS01D250	≥ 0.001%	Metallic Cu, AgNO ₃ digest, AAS
GC_ASQ01D50	≥ 0.001%	Sequential Cu leach (H ₂ SO ₄ soluble Cu, Cyanide soluble Cu, residual Cu), AAS
GC_ASQ02D100		
GC_ASQ03D50		

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

Fluorspar

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

SOLUBLE FLUORSPAR PACKAGE

CODE(S)	ELEMENTS/ LIMIT(S)	DESCRIPTION
GC_CLA27V	CaCO ₃ (≥ 0.1%)	EDTA Titration
	CaF ₂ (≥ 10%)	Calculation

Generic / Multi-element Ores

Generic Ore, concentrate and metallurgical materials compatible analytical methods with a wide dynamic range using XRF.

PYROSULPHATE FUSION / XRF BASE METAL PACKAGE (10 ELEMENTS)

GO_XRF70V

ELEMENTS AND LIMITS

Co 0.01 - 100%	Fe 0.02 - 100%	Ni 0.01 - 100%	Zn 0.01 - 100%
Cr 0.01 - 100%	Mn 0.005 - 100%	Pb 0.01 - 100%	
Cu 0.01 - 100%	Mo 0.005- 100%	W 0.02 - 100%	

WIDE RANGE ORE METHOD BASED ON PRESSED PELLET; USE OF AN INTERNAL STANDARD TO ALLOW FOR MATRIX CORRECTION

GO/GC_XRF75A/B/C/D

As 0.001 - 100% (A)	Sb 0.002 - 100% (A)	Nb 0.001 - 10% (D)	U 0.002 - 5% (A)
Sn 0.002 - 100% (B)	Ta 0.002 - 2% (D)	Th 0.005 - 10% (A)	W 0.002 - 20% (C)

Oxidizing Borate Fusion for Mineralized samples with sulphide, metal concentrates with sulphides, metallurgical samples. Wide range borate fusion for sulphide, concentrates and metallurgical samples using oxidizing borate fusion (NaNO₃). Upon special request and at some sites LiNO₃ as oxidizer is available allowing to report Na₂O. This method can be used for FeCr, FeMn. FeSi requires a dedicated method. Please enquire on availability.

**GO_XRF76**

Analyte	Reported as	Standard	Extension	Extension with REE	Range
Al	Al ₂ O ₃	X	X	X	0.01 - 100%
As	As ₂ O ₃	Optional	Optional	Optional	0.01 - 10%
Ba	BaO	X	X	X	0.01 - 40%
Bi	Bi ₂ O ₃		X		0.01 - 20%
Ca	CaO	X	X	X	0.01 - 80%
Ce	Ce ₂ O ₃			X	0.02 - 50%
Co	Co ₃ O ₄	Optional	X	X	0.01 - 100%
Cr	Cr ₂ O ₃	X	X	X	0.01 - 75%
Cu	CuO	X	X	X	0.01 - 75%
Cs	Cs ₂ O		Optional	Optional	0.01 - 25%
Dy	Dy ₂ O ₃			X	0.02 - 10%
Eu	Eu ₂ O ₃			X	0.02 - 10%
F	F	Optional	Optional	Optional	0.5 - 50%
Fe	Fe ₂ O ₃	X	X	X	0.01 - 100%
Gd	Gd ₂ O ₃			X	0.02 - 10%
Hf	HfO ₂	Optional	Optional	Optional	0.01 - 10%
K	K ₂ O	X	X	X	0.01 - 40%
La	La ₂ O ₃			X	0.02 - 50%
Mg	MgO	X	X	X	0.01 - 80%
Mn	Mn ₃ O ₄	X	X	X	0.01 - 100%
Mo	MoO ₃		X		0.01 - 50%
Na	Na ₂ O	Per Oxidizer	Per Oxidizer	Per Oxidizer	0.1 - 58%
Nb	Nb ₂ O ₃		X		0.01 - 50%
Nd	Nd ₂ O ₃			X	0.02 - 50%
Ni	NiO	X	X	X	0.01 - 5%
P	P ₂ O ₅	X	X	X	0.01 - 40%
Pb	PbO	X	X	X	0.01 - 100%
Pr	Pr ₆ O ₁₁			X	0.02 - 50%
Rb	Rb ₂ O		X	X	0.02 - 35%
Sb	Sb ₂ O ₃		X		0.01 - 25%
Si	SiO ₂	X	X	X	0.1 - 100%
Sm	Sm ₂ O ₃			X	0.02 - 10%
Sn	SnO ₂		X		0.01 - 40%
S	SO ₃	X	X	X	0.2 - 90%
Sr	SrO	Optional	X	X	0.01 - 20%
Ta	Ta ₂ O ₅		X		0.01 - 50%
Th	ThO ₂		X		0.01 - 3%
Ti	TiO ₂	X	X	X	0.01 - 80%
U	U ₃ O ₈		X		0.01 - 1%
V	V ₂ O ₅	X	X	X	0.01 - 10%
W	WO ₃		X		0.01 - 70%
Y	Y ₂ O ₃			X	0.02 - 10%
Zn	ZnO	X	X	X	0.01 - 70%
Zr	ZrO ₂	Optional	X		0.02 - 40%
LOI (1000°C)*		Optional	Optional	Optional	-10 - 100%
Moisture (as received)		Optional	Optional	Optional	≥ 0.01%

*G_PHY01V or G_PHY02V



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	C graphitic (0.05%)	Coulometry	0.1
GC_CSA05V	C graphitic (0.05%)	Leach; IR Combustion	0.2
GC_CSA06V	Total Carbon (0.01%)	IR Combustion	0.1 - 0.3
TM_AMC561_M	*Ash content (0.01-10%)	Gravimetric	20

Note: High temperature carbon analyzer available at some sites for carbon concentrates requiring greater precision. Contact your local representative.

*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_ICP95V100

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
Co ≥ 2 ppm	Mo ≥ 4 ppm	V ≥ 1 ppm
Cr ≥ 4 ppm	Na ≥ 5 ppm	Zn ≥ 20 ppm
Cu 1 ≥ 0ppm	Ni 4 ≥ ppm	Zr ≥ 0.3 ppm
Fe ≥ 20 ppm		

Requires a minimum sample weight of 20 g.

Note: Trace impurities are determined by lithium metaborate fusion with ICP-OES analysis on residue obtained by ashing (TM_AMC561_M). Additional impurity elements are available upon request. Graphitic carbon and impurity analysis are not available at all SGS locations, please enquire.



Iron Ore

Lithium borate fusion and WD XRF analysis is the industry method of choice for the analysis of oxide iron ores. Single or multi-temperature LOI is available, customizable as required. Borate Fusion ranges are available to accommodate ore grade, grade control and commercial analysis. High Magnetite containing Fe Ore will require oxidizing fusion (XRF76).

BORATE FUSION / XRF IRON ORE PACKAGE

GO_XRF72FE1

Al ₂ O ₃ 0.01 - 100%	K ₂ O 0.01 - 10%	Sn 0.01 - 1%
As 0.01 - 1%	MgO 0.01 - 100%	Sr 0.01 - 1%
Ba 0.01 - 1%	Mn 0.01 - 28%	TiO ₂ 0.01 - 50%
CaO 0.01 - 40%	Na ₂ O 0.01 - 2%	V 0.01 - 5%
Cl 0.01 - 1%	Ni 0.01 - 10%	Zn 0.01 - 1%
Co 0.01 - 5%	P 0.01 - 10%	Zr 0.01 - 1%
Cr ₂ O ₃ 0.01 - 10%	Pb 0.01 - 10%	LOI -10 - 100%*
Cu 0.01 - 5%	S 0.01 - 2%	
Fe 0.01 - 70%	SiO ₂ 0.01 - 100%	

*G_PHY01V or G_PHY02V

GO_XRF72FE2

ELEMENTS AND LIMIT(S)

Al ₂ O ₃ 0.01 - 100%	Mn 0.001 - 28%	Zn 0.001 - 1%
As 0.001 - 1%	Na ₂ O 0.05 - 2%	Zr 0.001 - 1%
Ba 0.001 - 1%	Ni 0.001 - 10%	LOI (1000°C) REQ*
CaO 0.01 - 40%	P 0.001 - 10%	LOI (650°C) Optional*
Cl 0.001 - 1%	Pb 0.001 - 10%	LOI (425°C) Optional*
Co 0.001 - 5%	SiO ₂ 0.01 - 100%	LOI (371°C) Optional*
Cr ₂ O ₃ 0.001 - 10%	Sn 0.001 - 1%	LOI (105°C) REQ*
Cu 0.001 - 5%	S 0.001 - 2%	
Fe 0.01 - 70%	Sr 0.001 - 1%	
K ₂ O 0.001 - 10%	TiO ₂ 0.01 - 50%	
MgO 0.01 - 100%	V 0.01 - 5%	

*G_PHY01V or G_PHY02V

VOLUMETRIC METHOD FOR IRON ORE

CODE	ELEMENT	LIMIT(S)	DESCRIPTION	MIN. SAMPLEWT.(g)
GC_CON08V	Fe	10 - 95%	Titration	0.25

Note: this method can be analyzed to party or umpire quality standards (GT).

The Satmagan test provides a measure of magnetic susceptibility on pulp samples, with results expressed as magnetic iron. The Davis Tube test, separates various magnetic mineral phases from non-magnetic components on a range of size fractions of crushed iron ore at various stages of mineral processing. This allows for mass and elemental balancing.

SGS offers various other magnetic separation techniques for separating ferromagnetic minerals from paramagnetic, diamagnetic and non-magnetic minerals, in tills, mineral sands and in mineral processing.

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



Limestone / Lime / Industrial Minerals / Cement / Clinker / Dolomite

Industry standard borate fusion XRF multielement method based on dried sample. LOI (G_PHY01V or G_PHY02V) required.

GC_XRF72LS

ANALYTE	REPORTED AS	RANGE
Al	Al ₂ O ₃	0.01 - 100%
As	As ₂ O ₃ Option	0.01 - 5%
Ba	BaO	0.01 - 5%
Ca	CaO	0.01 - 100%
Cl	Cl Option	0.01 - 1%
Co	Co ₃ O ₄ Option	0.01 - 1%
Cr	Cr ₂ O ₃	0.01 - 1%
Cu	CuO	0.01 - 1%
Fe	Fe ₂ O ₃	0.01 - 50%
K	K ₂ O	0.01 - 5%
Mg	MgO	0.01 - 100%
Mn	Mn ₃ O ₄	0.01 - 10%
Na	Na ₂ O	0.05 - 60%
Ni	NiO Option	0.01 - 1%
P	P ₂ O ₅	0.01 - 55%
Pb	PbO Option	0.01 - 5%
Si	SiO ₂	0.01 - 100%
Sn	SnO ₂ Option	0.01 - 5%
S	SO ₃	0.025 - 60%
Sr	SrO	0.01 - 5%
Ti	TiO ₂	0.01 - 50%
V	V ₂ O ₅	0.01 - 5%
Zn	ZnO	0.01 - 5%
Zr	ZrO ₂	0.01 - 5%
LOI (1000°C)*	LOI	-10 - 100%
Moisture (as received)		≥0.01%

Option E: Extension package

*G_PHY01V or G_PHY02V

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_IMS21B20 / GE_IMS22B20	1 - 10,000 ppm	2-Acid / aqua regia digest / ICP-OES
GE_ICP40Q12	1 - 10,000 ppm	4-Acid digest / ICP-OES
GE_ICP92A50	10 - 50,000 ppm	Sodium peroxide fusion / ICP-OES
GE_IMS90A50	5 - 10,000 ppm	Sodium peroxide fusion / ICP-MS

LITHIUM PACKAGES FOR HIGHER GRADE MINERALIZATION

CODE(S)	ELEMENTS/ LIMIT(S)	DESCRIPTION
GC_ICP92A50	≥10ppm	Sodium peroxide fusion / ICP-OES



Manganese Ore

Industry standard XRF borate fusion method with (76) and without (72) oxidation. LOI (G_PHY01V or G_PHY02V) required. Oxidation method (76) recommended for ores with variable oxidation states as well as Ferro Manganese and Manganese Nodules.

GO_XRF72MN /GO_XRF76MN

ANALYTE	REPORTING AS	RANGE
Al	Al ₂ O ₃	0.01 - 100%
Ba	BaO	0.01 - 5%
Ca	CaO	0.01 - 40%
Cr	Cr ₂ O ₃	0.01 - 10%
Fe	Fe ₂ O ₃	0.01 - 100%
K	K ₂ O	0.01 - 10%
Mg	MgO	0.01 - 100%
Mn	Mn ₃ O ₄	0.01 - 100%
Na	Na ₂ O (only on 72)	0.01 - 10%
P	P ₂ O ₅	0.01 - 10%
Si	SiO ₂	0.05 - 100%
S	SO ₃	0.01 - 2%
Ti	TiO ₂	0.01 - 50%
V	V ₂ O ₅	0.01 - 5%
Zr	ZrO ₂	0.01 - 1%
LOI (1000°C)*	LOI	-10 - 100%

Dried only; Optional Elements available upon request. *G_PHY01V or G_PHY02V

Nickel

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 GE_ICP21B20, GE_ICP22B20, GE_ICP40Q12, GE_ICP90A50 digestion techniques. For description of the GO_ICP21B100, GO_ICP42Q100 and GO_ICP90Q100 techniques, please see the Ore-Grade Analysis section.

EXPLORATION GRADE NICKEL METHODS

CODE(S)	LIMIT(S)	DESCRIPTION
GE_ICP22B20 / GC_ICP21B20	1 ppm - 1%	2-Acid digest / Aqua regia – ICP-OES
GE_IMS21B20 / GE_IMS22B20	0.5 ppm - 1%	2-Acid digest / Aqua regia – ICP-MS
GE_ICP40Q12	1 ppm - 1%	4-Acid digest – ICP-OES
GE_ICP90A50	10 ppm - 10%	Fusion – ICP-OES
GE_IMS90A50	5 ppm - 5%	Fusion – ICP-MS

ORE-GRADE NICKEL METHODS

CODE(S)	LIMIT(S)	DESCRIPTION
GO_ICP21B100	0.001 - 10%	Aqua regia digest – ICP-OES
GO_ICP42Q100	0.001 - 10%	4-Acid digest – ICP-OES
GO_ICP90Q100	0.01 - 30%	Fusion – ICP-OES

CONCENTRATE-GRADE NICKEL METHODS

CODE(S)	LIMIT(S)	DESCRIPTION
GC_CON07V*	5 - 100%	DMG separation / electroplating

* These methods can be done at party or umpire quality (GT).

MINERAL SELECTIVE NICKEL METHODS

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

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



Nickel Laterite

Industry standard XRF multielement method based on dried sample due to hygroscopic nature of the ore. LOI (G_PHY01 or G_PHY02V) required.

GO_XRF72NL

ANALYTE	REPORTED AS	RANGE
Al	Al ₂ O ₃	0.01 - 100%
As	As optional	0.01 - 1%
Ba	BaO	0.01 - 1%
Ca	CaO	0.01 - 40%
Co	Co	0.001 - 5%
Cr	Cr ₂ O ₃	0.005 - 10%
Cu	Cu	0.01 - 1%
Fe	Fe ₂ O ₃	0.01 - 100%
K	K ₂ O	0.01 - 10%
Mg	MgO	0.01 - 50%
Mn	MnO	0.01 - 40%
Na	Na ₂ O	0.01 - 5%
Ni	Ni	0.005 - 8%
P	P ₂ O ₅	0.01 - 5%
Pb	Pb	0.005 - 1%
Si	SiO ₂	0.05 - 100%
Sc	Sc ₂ O ₃ option	0.01 - 1%
S	SO ₃	0.01 - 1%
Ti	TiO ₂	0.01 - 1%
Zn	Zn	0.001 - 2%
LOI (1000°C)*	LOI	-10 - 100%

Dried sample only. *G_PHY01V or G_PHY02V



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 enquire 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_IMS40Q12	Pr, Nd, Sm, Eu, Gd, Dy, Ho, Er, Tm	4-Acid digest / ICP-MS

* REE elements that can be added to existing package

RARE EARTH ELEMENT INCLUSIVE TRACE PACKAGES

CODE(S)	ELEMENTS	DESCRIPTION
GE_ICM90A50	Refer to pg.51	Sodium peroxide fusion / ICP-OES / ICP-MS
GE_IMS95A50	Refer to pg.52	Lithium metaborate fusion / ICP-MS

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

GO_IMS91Q100

ELEMENTS AND LIMIT(S)

Ce 50 - 150,000 ppm	Ho 0.1 - 200 ppm	Sm 10 - 20,000 ppm	Y 5 - 10,000 ppm
Dy 1 - 5,000 ppm	La 50 - 50,000 ppm	Tb 1 - 500 ppm	Yb 1 - 200 ppm
Er 0.5 - 200 ppm	Lu 0.2 - 200 ppm	Th 5 - 50,000 ppm	
Eu 1 - 5,000 ppm	Nd 50 - 50,000 ppm	Tm 0.1 - 200 ppm	
Gd 5 - 5,000 ppm	Pr 10 - 20,000 ppm	U 1 - 200 ppm	

Note: This technique requires a minimum sample weight of 0.5 g.

Resistive Minerals / Tungsten Tin Ores / Concentrates

XRF method with high dilution borate fusion digest. Use GO_XRF76WSN for any sulphide, or metal containing samples.

GO_XRF72WSN/GO_XRF76WSN

Minimum sample 1g.

ANALYTE	REPORTING AS	RANGE
Al	Al ₂ O ₃	0.01 - 100%
As	As	0.01 - 1%
Ba	Ba	0.01 - 20%
Ca	CaO optional	0.01 - 40%
Co	Co	0.01 - 5%
Cr	Cr ₂ O ₃	0.01 - 60%
Cu	CuO optional	0.01 - 5%
Fe	Fe ₂ O ₃	0.05 - 100%
K	K ₂ O	0.01 - 10%
Mg	MgO	0.05 - 50%
Mn	MnO	0.01 - 15%
Na	Na ₂ O	0.1 - 10%
Nb	Nb ₂ O ₃	0.01 - 25%
Ni	NiO optional	0.01 - 10%
P	P ₂ O ₅	0.01 - 10%

ANALYTE	REPORTING AS	RANGE
Pb	PbO	0.01 - 5%
Si	SiO ₂	0.05 - 10%
Sn	SnO ₂	0.01 - 100%
S	SO ₃	0.01 - 2%
Sr	SrO	0.01 - 1%
Ta	Ta ₂ O ₅	0.01 - 50%
Th	ThO ₂ optional	0.01 - 1%
Ti	TiO ₂	0.01 - 50%
U	U ₃ O ₈ optional	0.01 - 5%
V	V ₂ O ₅ optional	0.01 - 5%
W	WO ₃	0.01 - 100%
Zn	ZnO	0.01 - 1%
Zr	ZrO ₂	0.01 - 1%
LOI (1000°C)*	LOI	-10 - 100%

Dried only

*G_PHY01V or G_PHY02V

Note: Additional grinding might be needed

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_IMS21B20 / GE_IMS22B20	0.05 - 10,000 ppm	2-Acid / aqua regia digest / ICP-MS
GE_IMS95A50	0.05 - 10,000 ppm	Lithium metaborate fusion / ICP-MS
GE_MMIME	≥0.5ppb	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_IMS91Q100	1 - 200 ppm	Sodium peroxide fusion / ICP-MS
GO_XRF/EDX 71UTH	0.0008 - 0.36%	Pressed pellet/powder XRF
GO_XRF72	0.01 - 4.2%	Borate fusion / XRF



Control Grade Analysis

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 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, IR combustion, coulometry 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-OES (30 ELEMENTS)

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 ≥ 0.5 ppm
Bi ≥ 10 ppm	Li ≥ 20 ppm	Sb ≥ 10 ppm	Zn ≥ 7 ppm
Ca ≥ 20 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. Requires a minimum sample weight of 1.0 g.

Multi-Acid (Four Acid) Digestion Packages

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

GC_ICP42C100

ELEMENTS AND REPORTING LIMIT(S)

Ag ≥ 2 ppm	Co ≥ 4 ppm	Mo ≥ 5 ppm	Sr ≥ 0.5 ppm
Al* ≥ 20 ppm	Cr* ≥ 10 ppm	Na ≥ 100 ppm	Ti* ≥ 5 ppm
As* ≥ 30 ppm	Cu ≥ 5 ppm	Ni ≥ 20 ppm	Tl ≥ 30 ppm
Ba* ≥ 0.05 ppm	Fe ≥ 100 ppm	P ≥ 30 ppm	V ≥ 2 ppm
Be ≥ 0.03 ppm	K* ≥ 20 ppm	Pb ≥ 20 ppm	Y ≥ 0.5 ppm
Bi ≥ 20 ppm	Li ≥ 10 ppm	Sb* ≥ 10 ppm	Zn ≥ 10 ppm
Ca* ≥ 100 ppm	Mg* ≥ 40 ppm	Se ≥ 30 ppm	
Cd ≥ 2 ppm	Mn ≥ 5 ppm	Sn* ≥ 20 ppm	

Additional elements can be added. An ICP-MS option is available. Requires a minimum sample weight of 1.0 g.

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

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

GC_ICP46C100

ELEMENTS AND REPORTING LIMIT(S)

Ag ≥ 2 ppm	Co ≥ 4 ppm	Mo ≥ 5 ppm	Sr ≥ 1 ppm
Al ≥ 100 ppm	Cr ≥ 10 ppm	Na ≥ 100 ppm	Ti ≥ 5 ppm
As* ≥ 30 ppm	Cu ≥ 5 ppm	Ni ≥ 20 ppm	Tl ≥ 30 ppm
Ba ≥ 2 ppm	Fe ≥ 100 ppm	P ≥ 30 ppm	V ≥ 2 ppm
Be ≥ 0.03 ppm	K ≥ 20 ppm	Pb ≥ 20 ppm	Y ≥ 0.5 ppm
Bi ≥ 20 ppm	Li ≥ 10 ppm	Sb* ≥ 10 ppm	Zn ≥ 10 ppm
Ca ≥ 100 ppm	Mg ≥ 40 ppm	Se ≥ 30 ppm	
Cd ≥ 2 ppm	Mn ≥ 5 ppm	Sn* ≥ 20 ppm	

Additional elements can be added. An ICP-MS option is available. Requires a minimum sample weight of 1.0 g.

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



Fusion Packages

FUSION / ICP-OES PACKAGE (28 ELEMENTS)

GC_ICP93A50V

ELEMENTS AND REPORTING LIMIT(S)

Ag 200 ppm - 1%	Co 200 ppm - 50%	Mo 300 ppm - 50%	Tl 2,000 ppm - 50%
Al 0.04% - 50%	Cr 200 ppm - 50%	Ni 300 ppm - 50%	V 80 ppm - 50%
As 1,200 ppm - 50%	Cu 40 ppm - 50%	Pb 800 ppm - 50%	Y 8 ppm - 50%
Ba 3 ppm - 50%	Fe 0.05% - 50%	Sb 400 ppm - 50%	Zn 300 ppm - 50%
Be 3 ppm - 50%	K 0.04% - 50%	Se 2,000 ppm - 50%	
Bi 400 ppm - 50%	Li 800 ppm - 50%	Sn 800 ppm - 50%	
Ca 0.1% - 50%	Mg 0.003% - 50%	Sr 10 ppm - 50%	
Cd 40 ppm - 50%	Mn 0.002% - 50%	Ti 0.02% - 50%	

Additional elements can be added. An ICP-MS option is available. Requires a minimum sample weight of 0.2 g.

FUSION / AAS

GC_AAS93A50V

ELEMENTS AND REPORTING LIMIT(S)

Al ≥ 0.02 %	Fe ≥ 0.07 %	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_XRF72	Same available range and elements as GO_XRF72, refer to ore grade analysis section	Borate fusion / XRF
GC_XRF70V	Same available range and elements as GO_XRF70V, refer to ore and commodities section	Pyrosulphate fusion / XRF
GC_XRF75	Refer to page 69 for elements and ranges	Internal standard / XRF

Process Solution Packages

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

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 10 mL. ICP-MS option may be available locally. Please enquire.

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

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 enquire.

INDIVIDUAL METHODS FOR CONTROL-GRADE ANALYSIS

SULPHUR AND CARBON

CODE(S)	ELEMENT	LIMIT(S)	DESCRIPTION	MIN. SAMPLE WT.(g)
GC_CSA06V	S	≥ 0.01%	IR combustion	0.1 - 0.3
	C	≥ 0.01%		0.1 - 0.3
GC_CSA08V	S ²⁻	≥ 0.05%	Leach/Digest/IR	2.0
GC_CLA01V	Fe ²⁺	≥ 0.5%	Ferrous iron titration	0.25

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

ADDITIONAL SINGLE ANALYTES

CODE(S)	ANALYTES	LIMITS	DESCRIPTION	MIN. SAMPLE WT.(g)
GC_CLA04V	Insolubles (acid)	≥ 0.05%	Gravimetric	1
GC_CLA03V	CaO	≥ 5%	Available lime	2
GC_ISE10V	pH (soils/sediments)	0.1 - 14	Ion selective electrode	20

SGS can analyze a number of individual ore-grade elements. Please enquire.

VOLUMETRIC AND GRAVIMETRIC METHODS FOR CONCENTRATES

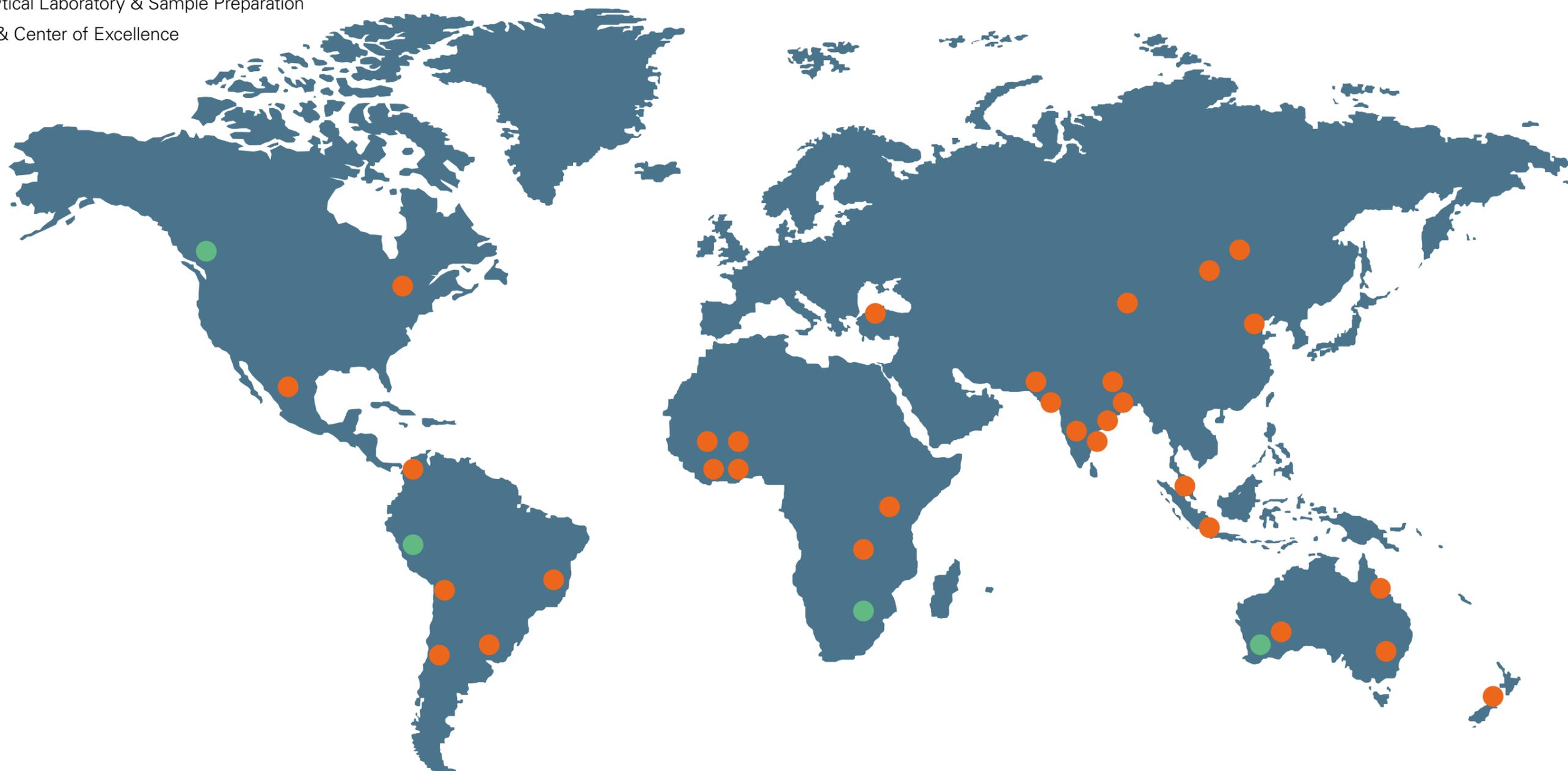
CODE(S)	ELEMENT	LIMIT(S)	DESCRIPTION	MIN. SAMPLE WT.(g)
GC_CON13V	Cu	15 - 60%	Titration	0.25
GC_CON03V	Cu	5 - 95%	Electroplating	1.0
GC_CON07V	Ni	5 - 100%	Electroplating	1.0
GC_CON11V	Pb	10 - 80%	Titration	2.0
GC_CON12V	Zn	10 - 80%	Titration	0.5
GC_CON08V	Fe	10 - 80%	Titration	0.25

Note: these elements can be analyzed to party or umpire quality standards (GT). Additional elements can be determined on concentrate samples in some SGS laboratories. Please enquire. Trade sample analyzes typically require moisture analysis and may require a larger minimum sample weight.



Geochemistry Commercial Laboratories Map

- Analytical Laboratory & Sample Preparation
- Hub & Center of Excellence



SGS Hub & Center of Excellence details:

SGS Canada

3260 Production Way
Burnaby V5A 4W4
+1 604 638 2349

SGS Peru

Avenue Elmer Faucett
Callao 3348
+51 99984 0027

SGS South Africa

Zuurbekom Road
Randfontein 1760
+27 111002170

SGS Australia

28 Reid Road
Newburn WA 6105
+61 8 9373 3640



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 – 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. More information can be found at www.sgs.com/FAST.

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. Precious metals, Au, 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 enquire.

The FAST services currently offered globally are:

- Mobile Sample Preparation Units (MSPUs)
- WD-XRF Core Scanning systems
- Portable XRF analysis systems (pXRF)
- FTIR analysis systems (FTIR)
- Machine learning and advanced data analysis

Portable XRF (pXRF) (Chemistry / Elemental analysis)

SGS offers a range of analytical techniques which generate indicative assay results, making use of a generic calibration setup and generic Quality Control samples (mid to low mineralized sediment, mineralized mine rock) with a wide analytical range. Portable XRF is the ideal technique for screening large volumes of samples for a comprehensive element

range, and concentration ranges spanning exploration to ore grade mineralization(s). Highly mineralized samples, process feeds, materials and concentrates can also be screened either in the sample bag, or as prepared pulp. This flexibility allows its use throughout the whole mining cycle, from exploration, to process control to remediation.

SGS offers pXRF with client specific calibrations, which are superior to the traditional type standardization approach. This allows for a wider operating range, and can model the mineralogical and grain size range of the specific material.

For high grade ore, process materials and concentrates, it is recommended that a quality control setup be implemented. This will mitigate the high risk of inaccurate results, as well as false positives. When analyzing materials in the sample bag, the analysis needs to be calibrated for the respective bag used. It is also imperative that all samples are in the same type/model bag. Some elements such as Ca, S, Ti, Zn might be part of the composition of the sample bag, which limits their detection in the sample.

For larger volumes of samples, SGS offers a customized matrix matched setup, which is site specific. This includes range-targeted Quality Control

materials to allow for JORC compliance, as well as consistent input for geochemical modelling and machine learning.

These applications are also adjusted and continuously monitored to ensure the highest consistency and prompt reaction to any mineralogical change.

Historical measurement data can also be reprocessed with the updated application, to further increase data quality and additional elements can also be added.

As part of the FAST offering, the on-site analytical techniques, including pXRF, can be deployed to the client site or a designated SGS preparation laboratory.

The FAST project techniques are all set up to be matrix or site specific. The SGS Quality Control calibrations are traceable, with either matrix matched reference material (MMRM) or site specific reference material (SSRM). The application is continuously checked by performing confirmation analysis on 5-20% of the site samples at an SGS commercial Laboratory. This confirmation analysis can also be used to improve a generic calibration to a site-specific calibration.

Please [contact](#) the Customer Service representative for your region for more information and advice on selecting the method and application for your project.



Annexes



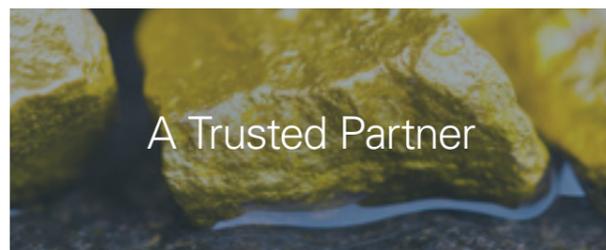
SGS Code of Integrity



SGS Quality & Professionalism Business Principles



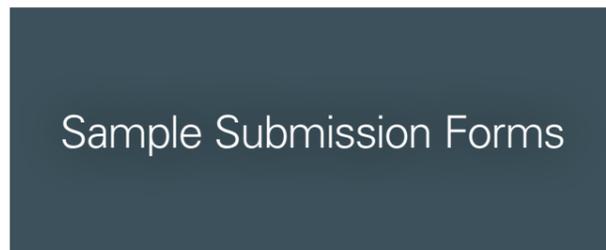
Quality & Responsiveness



A Trusted Partner



Conversion Factors



Sample Submission Forms

SGS Code of Integrity

The SGS Code of Integrity has been approved by our Board of Directors and the Operations Council. It applies to all of our employees, officers and directors and our affiliated companies.

All aspects of the Code which are not specifically related to our employees must also be adhered to by contractors, consultants, freelancers, joint-venture partners, agents, subcontractors and anyone acting on behalf of, or representing, SGS.

The Code defines the main principles of professional integrity and is an expression of the values that are shared throughout SGS, our various businesses and our affiliates. Referring to it should help anyone acting for SGS to make the correct decisions while carrying out their work.

Our code of integrity obliges us to :

- Behave with integrity and responsibly
- Abide by the rules, laws and regulations of the countries we are operating in
- Encourage us to speak up and be confident enough to raise concerns and consider any that are brought to us

SGS Code of Integrity is available in 30 languages on our [website](#).



SGS Quality & Professionalism Business Principles

Business Principles and the cornerstones for ensuring high levels of customer satisfaction. Through mutually beneficial partnerships and continued operational excellence we ensure the long-term sustainability of our business.

Our aim:

- Deliver world-class services that meet our customers' needs.
- Build strong customer relationships based on trust, mutual respect and the prioritization of the needs of the customer.
- Be known and recognized for our superior knowledge, reliability, accuracy and consistency.
- Nurture and encourage a culture of quality within SGS with the full support of management and engagement of all employees.

It is therefore our commitment to:

- Place customers at the heart of everything we do, engaging proactively with their needs.
- Maintain flexibility, listening to industry and customer needs and expectations and actively evolving our quality statement to meet them.

- Continuously challenge ourselves to improve our quality management system by setting and reviewing our objectives, risks, KPIs, results and customer satisfaction levels.
- Develop and maintain the processes we need to deliver high quality, optimized and coherent services.
- Continuously measure, maintain and increase our knowledge base through sustainable processes of talent recruitment and training.
- Respect client confidentiality and individual privacy while remaining transparent in all other aspects of our work.
- Protect our intellectual property and know-how.
- Embody the SGS brand and its independence in all that we do.

Delivering quality and professionalism is an individual responsibility for all of us, at every level within our organization. These commitments apply to all SGS employees and contractors. Management is responsible for ensuring full compliance with SGS policies.

Quality & Responsiveness

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 analyzes 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, monitored, accessible and followed.

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 laboratories 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 [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 platform, SLIM, 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.



A Trusted Partner

SGS' Centres of Excellence conform to the ISO/IEC 17025 standard and most of our major regional laboratories are ISO/IEC 17025 accredited. 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, analyzes 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. 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. A SGS professional is also always available to assist you with analytical technique selection.

Laboratory Information Management System

SGS is currently in the process of upgrading our IT systems which includes implementing a new version of our Laboratory Information Management System.

As we transition to the new systems we have further standardized our global reference data. This has resulted in some changes to LIMS reference information and codes that are used in the configuration and set-up of the system.

- 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 with determinative procedures highlighted. This table groups elements into analytical schemes which you can use to pick the best analytical method for your needs.

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 analyzes.

Data Turnaround

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

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).

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 enquire.

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

Sample Submission Forms

SGS – Geochemistry

Sample Submittal Form

For Lab Use Work Order No: _____ Date Received: _____



SGS LAB LOCATION:

SUBMISSION DETAILS			
Submitted by:			
Company Name:			
Telephone:			
Email:			
Courier/Waybill:			
Country of sample origin:			
REPORTING INSTRUCTIONS			
Report to:			
Company Name:			
Telephone:			
Address:			
City:		Province/State:	
Country:		Postal/Zip Code:	
Email 1:	PDF	XLS	CSV
Email 2:	PDF	XLS	CSV
Email 3:	PDF	XLS	CSV
Email 4:	PDF	XLS	CSV
Final report and invoice will be sent by PDF email. For SGS Terms and Conditions see https://www.sgs.com/en/terms-and-conditions			

ATTENTION TO:

INVOICING DETAILS	
PO No.:	SGS Quote:
Invoice to:	Same as Report
Company Name:	
Telephone:	
Address:	
City:	Province/State:
Country:	Postal/Zip Code:
Email 1:	
Email 2:	
SAMPLE FATE	
Unless otherwise indicated, storage will be charged.	
Rejects	Pulps
Return after 30 days	Return after 90 days
Dispose after 30 days	Dispose after 90 days
Paid storage after 30 days	Paid storage after 90 days
Return Attention to:	
Return Address:	
Carrier:	
Acct No.:	

SAMPLE IDENTIFICATION AND ANALYSIS INSTRUCTIONS

Rush Turn Around Time (TAT) requests must be approved by the laboratory. A surcharge will apply.

Project Name:	Standard TAT	Rush TAT	
Sample Type:	Core	Rocks	
	Sediments	Pulp	
	Concentrates	Metal	
	Others:		
Analysis Type:	Exploration grade	Ore grade	
	Control grade	Party grade	
		Umpire grade	
Special Instructions:			
IMPORTANT: If samples are known to contain hazardous material please label accordingly Asbestos NORM			
SAMPLE IDs	SAMPLE PREPARATION AND ASSAYS REQUESTED		Key Elements
From:	To:	No.	Preparation Analysis (SGS Analytical Codes or Elements) of Interest
Total number of samples submitted:	See attached Excel file for sample IDs	See attached Excel file for analysis required	
Client Authorization (signature):	Date:		

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Email us at naturalresources@sgs.com
Website: www.sgs.com/geochemistry

SGS Géochimie

Formulaire d'envoi d'échantillons

Pour usage en laboratoire n° de bon de travail : _____ Date de réception : _____



COORDONNÉES DU LABORATOIRE DE SGS :

DÉTAIL DE L'ENVOI			
Envoyé par :			
Nom de l'entreprise :			
Téléphone :			
Courriel :			
Bordereau d'expédition/service de messagerie :			
Pays d'origine de l'échantillon :			
RAPPORT			
Rapport envoyé à :			
Nom de l'entreprise :			
Téléphone :			
Adresse :			
Ville :		Province/État :	
Pays :		Code postal/Zip :	
Courriel 1 :	PDF	XLS	CSV
Courriel 2 :	PDF	XLS	CSV
Courriel 3 :	PDF	XLS	CSV
Courriel 4 :	PDF	XLS	CSV
Le rapport final et la facture seront envoyés par courriel en format PDF. Pour les conditions générales de SGS, voir : https://www.sgs.com/en/terms-and-conditions			

À L'ATTENTION DE :

DÉTAILS DE FACTURATION	
n° de bon de commande :	Devis de SGS :
Facturer à :	Mêmes informations qu'à la section « Rapport »
Nom de l'entreprise :	
Téléphone :	
Adresse :	
Ville :	Province/État :
Pays :	Code postal/Zip :
Courriel 1 :	
Courriel 2 :	
SORT DE L'ÉCHANTILLON. Sauf indication contraire, des frais de stockage seront facturés.	
Rejects	Pulps
Retour après 30 jours	Retour après 90 jours
Éliminer après 30 jours	Éliminer après 90 jours
Frais de stockage après 30 jours	Frais de stockage après 90 jours
Retourner à l'attention de:	
Adresse de retour :	
Transporteur :	
n° de compte :	

Instructions pour l'identification et l'analyse des échantillons. Les demandes de temps de traitement urgents doivent être approuvées par le laboratoire. Un supplément s'appliquera.

Nom du projet :	Temps de traitement standard	Temps de traitement urgent	
Type d'échantillon :	Carotte	Roches	
	Sédiments	Pulpe	
	Concentrés	Métal	
	Autre :		
Type d'analyse :	Exploration	Minerai	
	Contrôle de procédé	Tierce partie/laboratoire arbitrage	
IMPORTANT : si les échantillons contiennent des matières dangereuses, elles doivent être étiquetées en conséquence			
MRN (matière radioactive naturelle)		Amiante	
		Autre :	
Instructions spéciales : voir ci-joint ou :			
IDENTIFICATION DES ÉCHANTILLONS	PRÉPARATION ET ANALYSES DES ÉCHANTILLONS DEMANDÉS		Principaux éléments
De :	À :	N°	Préparation Analyse (SGS – codes ou éléments d'analyse) d'intérêt
Nombre total d'échantillons envoyés:	Voir le document ci-joint pour les numéros d'identification des échantillons		Voir le document ci-joint pour l'analyse requise
Autorisation du client (signature) :	Date :		

GQF-MIN-03_FR rev 0.0. Publié Jan 2022

Envoyez-nous un courriel à : naturalresources@sgs.com
Site Web et Guide des Services: www.sgs.com/geochemistry



Geoquímica SGS

Formulario de presentación de muestras



Para uso del laboratorio Número de orden de trabajo: _____ Fecha de recepción: _____

UBICACIÓN DEL LABORATORIO DE SGS:

INFORMACIÓN DE ENVÍO			
Presentado por:			
Nombre de la Compañía:			
Teléfono:			
Correo electrónico:			
Mensajería/Conocimiento de embarque:			
País de origen de la muestra:			
INSTRUCCIONES DE INFORMACIÓN			
Informar a:			
Nombre de la Compañía:			
Teléfono:			
Dirección:			
Ciudad:		Provincia/Estado:	
País:		Código postal:	
Correo electrónico 1:	PDF	XLS	CSV
Correo electrónico 2:	PDF	XLS	CSV
Correo electrónico 3:	PDF	XLS	CSV
Correo electrónico 4:	PDF	XLS	CSV
El informe final y la factura se enviarán en formato PDF via correo electrónico. Los Términos y Condiciones de SGS pueden consultarse en https://www.sgs.com/en/terms-and-conditions			

ATENCIÓN:

INVOICING DETAILS	
n.o de PO:	Cotización de SGS:
Facturar a nombre de:	Igual al informe
Nombre de la compañía:	
Teléfono:	
Dirección:	
Ciudad:	Provincia/Estado:
País:	Código postal:
Correo electrónico 1:	
Correo electrónico 2:	
DESTINO DE LA MUESTRA	
A menos que se indique lo contrario, se cobrará por el servicio de almacenamiento.	
Rechazos	Pulpas
Devolución después de 30 días	Devolución después de 90 días
Eliminación después de 30 días	Eliminación después de 90 días
Pago de almacenamiento después de 30 días	Pago de almacenamiento después de 90 días
Comunicar la devolución a:	
Dirección de devolución:	
Transportista:	
Número de cuenta:	

IDENTIFICACIÓN DE LA MUESTRA E INSTRUCCIONES DE ANÁLISIS

Las solicitudes para Plazos de entrega (TAT, por sus siglas en inglés) urgentes deben contar con la aprobación del laboratorio. Se aplicará un recargo.

Nombre del proyecto:		TAT estándar	TAT urgente		
Tipo de muestra:	Testigo	Rocas	Sedimentos	Pulpa	Suelo
	Concentrados	Metal	Otros:		
Tipo de análisis:	Ley de exploración	Ley del mineral	Ley de control	Ley de las partes	Ley de arbitraje
Instrucciones especiales:					
IMPORTANTE: si se tiene conocimiento de que las muestras contienen materiales peligrosos, deberán etiquetarse según corresponda. Asbestos NORM					
IDENTIFICACIÓN DE LA MUESTRA		PREPARACIÓN DE MUESTRAS Y ENSAYOS SOLICITADOS			Elementos de interés clave
de:	para:	N.º	Preparación	Análisis (Códigos analíticos o elementos de SGS)	clave
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Autorización del cliente (firma):	Fecha:				

GQF-MIN-03_SP Fecha de emisión enero de 2022

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