SGS	**Geochemistry** **Global**	Doc Type **Method Summary** Method No: Code **GE_ICM40Q12** Service **Testing** Issued Date **April 2022**
Natural Resources	**Preparation and Determination of Forty-Nine (49) Elements in Exploration Samples using Multi-Acid Digestion and a Combination of Inductively Coupled Plasma – Optical Emission Spectrometry and Inductively Coupled Plasma - Mass Spectrometry** [Ag, Al, As, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cs, Cu, Fe, Ga, Hf, In, K, La, Li, Lu, Mg, Mn, Mo, Na, Nb, Ni, P, Pb, Rb, S, Sb, Sc, Se, Sn, Sr, Ta, Te, Tb, Th, Tl, Ti, U, V, W, Y, Yb, Zn, Zr; ICP-AES, ICP-MS]	Approved by **K.Williams**

1. **Parameter(s) measured, unit(s):**
   Silver (Ag); Arsenic (As); Barium (Ba); Beryllium (Be); Bismuth (Bi); Cadmium (Cd); Cerium (Ce); Chromium (Cr); Cobalt (Co); Cesium (Cs); Copper (Cu); Gallium (Ga); Hafnium (Hf); Indium (In); Lanthanum (La); Lithium (Li); Lutetium (Lu); Manganese (Mn); Molybdenum (Mo); Niobium (Nb); Nickel (Ni); Lead (Pb); Rubidium (Rb); Antimony (Sb); Scandium (Sc); Selenium (Se); Tin (Sn); Strontium (Sr); Tantalum (Ta); Tellurium (Te); Terbium (Tb); Thallium (Tl); Thorium (Th); Uranium (U); Vanadium (V); Tungsten (W); Yttrium (Y); Ytterbium (Yb); Zinc (Zn); Zirconium (Zr), in ppm
   Aluminum (Al); Calcium (Ca); Iron (Fe); Potassium (K); Magnesium (Mg); Sodium (Na); Phosphorus (P); Sulphur (S); Titanium (Ti) in %

2. **Typical sample size:**
   0.2 g

3. **Type of sample applicable (media):**
   Crushed and Pulverized exploration grade samples (rocks, soils and sediments)

4. **Sample preparation technique used:**
   Weighed representative samples are digested with HCl, HNO_3, HF and $HCLO_4$ and heated until dry. The residue is then dissolved in HNO_3 and HCl.

5. **Method of analysis used:**
   The digested sample solution is analyzed by inductively coupled plasma Mass Spectrometer (ICP-MS) and inductively coupled plasma Optical Emission Spectrometer (ICP-OES).

6. **Data reduction by:**
   Computer, on line, data fed to SGS Laboratory Information Management System with secure audit trail.

7. Figures of Merit:

This method has been fully validated for the range of samples typically analyzed. Method validation includes the use of certified reference materials, replicates, duplicates and blanks to calculate accuracy, precision, linearity, range, limit of detection, reporting limit, specificity and measurement uncertainty.

The Reporting Limit has been determined as follows:

Element	Reporting Limit (ppm)	Upper Limit	Element	Reporting Limit (ppm)	Upper Limit	Element	Reporting Limit (ppm)	Upper Limit
Ag	0.02	100 ppm	**K**	0.01(%)	15%	Se	1	0.1%
Al	0.01 (%)	15%	La	0.05	1.0%	Sn	0.2	0.1%
As	1	1.0%	Li	0.2	1.0%	**Sr**	0.5	1.0%
Ba	1	1.0%	Lu	0.01	0.1%	Ta	0.05	1.0%
Be	0.05	0.25%	**Mg**	0.002(%)	15%	Tb	0.05	1.0%
Bi	0.01	1.0%	**Mn**	2	1.0%	Te	0.05	0.10%
Ca	0.005(%)	15%	Mo	0.05	1.0%	Th	0.01	1.0%
Cd	0.02	1.0%	**Na**	0.005(%)	15%	**Ti**	0.001(%)	15%
Ce	0.05	0.1%	Nb	0.1	0.1%	Tl	0.02	1.0%
Co	0.1	1.0%	**Ni**	1	1.0%	U	0.05	1.0%
Cr	1	1.0%	**P**	0.001 (%)	15%	**V**	2	1.0%
Cs	0.05	0.1%	Pb	0.5	1.0%	W	0.1	1.0%
Cu	0.5	1.0%	Rb	0.1	1.0%	Y	0.1	1.0%
Fe	0.01(%)	15%	**S**	0.005(%)	5.0%	Yb	0.1	0.1%
Ga	0.05	0.05%	Sb	0.05	1.0%	**Zn**	1	1.0%
Hf	0.02	0.05%	Sc	0.1	1.0%	Zr	0.5	1.0%
In	0.005	0.05%						

Note: Bolded elements are generally reported by ICP-OES.

8. Quality control:

Quality control materials include method blanks, replicates and reference materials and are randomly inserted with the frequency set according to method protocols at ~11%. Quality control materials will also include BRM (Barren reference materials, or preparations blanks) and preparation duplicates if samples have been taken through the sample reduction process. Instrument calibration is performed for each batch or work order and calibration checks are analyzed within each analytical run.

9. Accreditation:

SGS Natural Resources conforms to the requirements of ISO/IEC 17025. Scopes of Accredited tests are site specific, please visit https://www.scc.ca/en/search/laboratories