18.2 APÉNDICE IV – Métodos de ensaye ALS Chemex

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Fire Assay Procedure - Au-ICP21 and Au-ICP22
Fire Assay Fusion ICP-AES Finish

Sample Decomposition: Fire Assay Fusion (FA-FUSPG1 & FA-FUSPG2)

Analytical Method: Inductively Coupled Plasma – Atomic Emission Spectrometry (ICP-AES)

A prepared sample is fused with a mixture of lead oxide, sodium carbonate, borax, silica and other reagents as required, inquarted with 6 mg of gold-free silver and then cupelled to yield a precious metal bead.

The bead is digested in 0.5 mL dilute nitric acid in the microwave oven. 0.5 mL concentrated hydrochloric acid is then added and the bead is further digested in the microwave at a lower power setting. The digested solution is cooled, diluted to a total volume of 4 mL with de-mineralized water, and analyzed by inductively coupled plasma atomic emission spectrometry against matrix-matched standards.

Method Code	Element	Symbol	Units	Sample Weight (g)	Lower Limit	Upper Limit	Default Overlimit Method
Au-ICP21	Gold	Au	ppm	30	0.001	10	Au-AA25
Au-ICP22	Gold	Au	ppm	50	0.001	10	Au-AA26

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Whole Rock Geochemistry – ME-ICP06 and OA-GRA05
Analysis of major oxides by ICP-AES

ME-ICP06

Sample Decomposition: Lithium Metaborate/Lithium Tetraborate ($LiBO_2/Li_2B_4O_7$) Fusion* (FUS-LI01)

Analytical Method: Inductively Coupled Plasma - Atomic Emission Spectroscopy (ICP-AES)

A prepared sample (0.200 g) is added to lithium metaborate/lithium tetraborate flux (0.90 g), mixed well and fused in a furnace at 1000°C. The resulting melt is then cooled and dissolved in 100 mL of 4% nitric acid/2% hydrochloric acid. This solution is then analyzed by ICP-AES and the results are corrected for spectral inter-element interferences. Oxide concentration is calculated from the determined elemental concentration and the result is reported in that format.

Element	Symbol	Units	Lower Limit	Upper Limit
Aluminum	Al_2O_3	%	0.01	100
Barium	BaO	%	0.01	100
Calcium	CaO	%	0.01	100
Chromium	Cr_2O_3	%	0.01	100
Iron	Fe_2O_3	%	0.01	100
Magnesium	MgO	%	0.01	100
Manganese	MnO	%	0.01	100
Phosphorus	P_2O_5	%	0.01	100
Potassium	K_2O	%	0.01	100
Silicon	SiO_2	%	0.01	100
Sodium	Na_2O	%	0.01	100
Strontium	SrO	%	0.01	100
Titanium	TiO_2	%	0.01	100

***Note**: For samples that are high in sulphides, we may substitute a peroxide fusion in order to obtain better results.

OA-GRA05, ME-GRA05

Sample Decomposition: Thermal decomposition Furnace or TGA (OA-GRA05 or ME-GRA05)

Analytical Method: Gravimetric

If required, the total oxide content is determined from the ICP analyte concentrations and loss on Ignition (L.O.I.) values. A prepared sample (1.0 g) is placed in an oven at 1000°C for one hour, cooled and then weighed. The percent loss on ignition is calculated from the difference in weight.

Method Code	Parameter	Symbol	Units	Lower Limit	Upper Limit
OA-GRA05	Loss on Ignition (Furnace)	LOI	%	0.01	100
ME-GRA05	Loss on Ignition (TGA)	Moisture	%	0.01	100
		LOI	%	0.01	100

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Geochemical Procedure – ME-ICP61
Trace Level Methods Using Conventional ICP-AES Analysis

Sample Decomposition: HNO_3-$HClO_4$-HF-HCl digestion, HCl Leach (GEO-4ACID)

Analytical Method: Inductively Coupled Plasma - Atomic Emission Spectroscopy (ICP - AES)

A prepared sample (0.25 g) is digested with perchloric, nitric, hydrofluoric and hydrochloric acids. The residue is topped up with dilute hydrochloric acid and the resulting solution is analyzed by inductively coupled plasma-atomic emission spectrometry. Results are corrected for spectral interelement interferences.

NOTE: Four acid digestions are able to dissolve most minerals; however, although the term "*near-total*" is used, depending on the sample matrix, not all elements are quantitatively extracted.

Element	Symbol	Units	Lower Limit	Upper Limit	Default Overlimit Method
Silver	Ag	ppm	0.5	100	Ag-OG62
Aluminum	Al	%	0.01	50	
Arsenic	As	ppm	5	10000	
Barium	Ba	ppm	10	10000	
Beryllium	Be	ppm	0.5	1000	
Bismuth	Bi	ppm	2	10000	
Calcium	Ca	%	0.01	50	
Cadmium	Cd	ppm	0.5	500	
Cobalt	Co	ppm	1	10000	Co-OG62
Chromium	Cr	ppm	1	10000	
Copper	Cu	ppm	1	10000	Cu-OG62

Element	Symbol	Units	Lower Limit	Upper Limit	Default Overlimit Method
Iron	Fe	%	0.01	50	
Gallium	Ga	ppm	10	10000	
Potassium	K	%	0.01	10	
Lanthanum	La	ppm	10	10000	
Magnesium	Mg	%	0.01	50	
Manganese	Mn	ppm	5	100000	
Molybdenum	Mo	ppm	1	10000	Mo-OG62
Sodium	Na	%	0.01	10	
Nickel	Ni	ppm	1	10000	Ni-OG62
Phosphorus	P	ppm	10	10000	
Lead	Pb	ppm	2	10000	Pb-OG62
Sulphur	S	%	0.01	10	
Antimony	Sb	ppm	5	10000	
Scandium	Sc	ppm	1	10000	
Strontium	Sr	ppm	1	10000	
Thorium	Th	ppm	20	10000	
Titanium	Ti	%	0.01	10	
Thallium	Tl	ppm	10	10000	
Uranium	U	ppm	10	10000	
Vanadium	V	ppm	1	10000	
Tungsten	W	ppm	10	10000	
Zinc	Zn	ppm	2	10000	Zn-OG62

Elements listed below are available upon request

Element	Symbol	Units	Lower Limit	Upper Limit	Default Overlimit Method
Lithium	Li	ppm	10	10000	
Niobium	Nb	ppm	5	2000	
Rubidium	Rb	ppm	10	10000	
Selenium	Se	ppm	10	1000	
Tin	Sn	ppm	10	10000	
Tantalum	Ta	ppm	10	10000	
Tellurium	Te	ppm	10	10000	
Yttrium	Y	ppm	10	10000	
Zirconium	Zr	ppm	5	500	

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Assay Procedure – ME-ICP81
Evaluation of Ores and High Grade Materials by Fusion-ICP-AES

Sample Decomposition: Sodium Peroxide Fusion (FUS-PER02)
Analytical Method: Inductively Coupled Plasma - Atomic Emission Spectroscopy (ICP-AES)

A prepared sample (0.200 g) is added to sodium peroxide flux (2.6 g), mixed well and then fused in a 670°C furnace. The resulting melt is cooled and then dissolved in 250 mL of 30% hydrochloric acid. This solution is then analyzed by inductively coupled plasma – atomic emission spectrometry and the results are corrected for spectral interelement interferences.

Element or Oxide	Symbol	Units	Lower Limit	Upper Limit
Aluminum Oxide	Al_2O_3	%	0.01	30
Arsenic	As	%	0.01	10
Calcium Oxide	CaO	%	0.01	30
Cobalt	Co	%	0.002	30
Chromium	Cr	%	0.01	30
Copper	Cu	%	0.005	30
Iron	Fe	%	0.05	100
Iron Oxide	Fe_2O_3	%	0.10	100
Magnesium Oxide	MgO	%	0.01	30
Manganese Oxide	MnO	%	0.01	30
Nickel	Ni	%	0.005	30
Lead	Pb	%	0.01	30

Element or Oxide	Symbol	Units	Lower Limit	Upper Limit
Sulfur	S	%	0.01	60
Silicon	Si	%	0.01	45
Silicon Oxide	SiO_2	%	0.01	100
Titanium Oxide	TiO_2	%	0.01	50
Zinc	Zn	%	0.01	30

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Specialty Assay Procedure – OA-GRA08
Specific Gravity

Analytical Method: Gravimetric

Two methods of analysis can be used, depending on the nature of the sample.

1. Bulk Samples (OA-GRA08 & OA-GRA08a)

The rock or core section (up to 6 kg) is weighed dry for method OA-GRA08 or is covered in a paraffin wax coat in the case of OA-GRA08a and weighed. The sample is then weighed while it is suspended in water. The specific gravity is calculated from the following equations.

OA-GRA08: $$\text{Specific Gravity} = \frac{\text{Weight of sample (g)}}{\text{Weight in air (g) - Weight in water (g)}}$$

Or

OA-GRA08a: $$\text{Specific Gravity} = \frac{A}{B - C - [(B - A) / Dwax]}$$

where: A = weight of sample in air
B = weight of waxed sample in air
C = weight of waxed sample suspended in water
D = density of wax

2. Pulverized Material (OA-GRA08b & OA-GRA08d)

A prepared sample (3.0 g) is weighed into an empty pycnometer. The pyncometer is filled with a solvent (either methanol or acetone) and then weighed. From the weight of the sample and the weight of the solvent displaced by the sample, the specific gravity is calculated according to the equation below.

$$\text{Specific Gravity} = \frac{\text{Weight of sample (g)}}{\text{Weight of solvent displaced (g)}} \times \text{Specific Gravity of Solvent}$$

Method Code	Units	Sample Type	Lower Limit	Upper Limit	Description
OA-GRA08	Unity	Bulk	0.01	20	Specific Gravity – without paraffin coat
OA-GRA08a	Unity	Bulk	0.01	20	Specific Gravity – with paraffin coat
OA-GRA08b	Unity	Pulp	0.01	20	Specific Gravity – pyncometer with Methanol
OA-GRA08d	Unity	Pulp	0.01	20	Specific Gravity – pyncometer with Acetone

Conversion of Specific Gravity to Density

Density = Specific gravity x Density of water (at temperature (t°C))

Factors for converting specific gravity to density are tabulated below:

Temp (°C)	Density (g/cm^3)	Temp (°C)	Density (g/cm^3)
19	0.9984	23	0.9975
20	0.9982	24	0.9973
21	0.998	25	0.997
22	0.9978	26	0.9968